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Systematics and Host Relationships of the Cuckoo Bee Genus *Oreopasites* (Hymenoptera: Anthophoridae: Nomadinae)

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CONTENTS

Abstract 2
Introduction 2
Acknowledgments 3
Relationships of *Oreopasites* to Other Nomadinae 3
Genus *Oreopasites* Cockerell 6
Phylogenetic Relationships of Species 7
Host Associations, Host Specificity, and Effects of Host Evolution 12
Key to Species 18
Subgenus *Oreopasites* Cockerell 20
Oreopasites vanduzeei Cockerell 20
Oreopasites albinota Linsley 33
Oreopasites scituli Cockerell 35
Oreopasites arizonica Linsley 37
Oreopasites hurdi, new species 39
Oreopasites euphorbiae Cockerell 40
Oreopasites collegarum, new species 43
Oreopasites favreauae, new species 44
Oreopasites powelli, new species 47
Perditopasites, new subgenus 49
Oreopasites linsleyi, new species 49
Oreopasites barbarae, new species 53
References 55

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ABSTRACT

The western North American cuckoo bee genus *Oreopasites* is revised. Evidence indicates that it is most closely related to the Old World ammobatine genera *Ammobates, Parammobatodes,* and *Melanempis*. Eleven species are recognized, six of which are new: *O. hurdi, O. collegarum, O. favreauae, O. powelli, O. linsleyi,* and *O. barbarae*. *Oreopasites linsleyi* is designated the type species of a new subgenus *Perditopasites*, which also includes *O. barbarae*. A key to species is presented, all species are described (or redescribed), and their important taxonomic features are illustrated. Species distributions are mapped, and phylogenetic relationships are evaluated. *Oreopasites vanduzeei* is the most wide-ranging, polytypic species. Although it had been divided into subspecies, these subdivisions are no longer justified in light of new knowledge of anatomical variation, hosts, and distributions. Consequently the following subspecific names applied to it are placed in synonymy: *diabloensis* Linsley, *melanantha* Linsley, *vernalis* Linsley, and *xerophila* Linsley.

The hosts or suspected hosts of all but three species have been discovered and are listed. All hosts belong to the highly specialized Calliopsini and Perditini, exclusively New World tribes of the andrenid bee subfamily Panurginae. *Oreopasites* s.s. is restricted to certain North American subgenera of *Calliopsis*: *Nomadopsis*, *Macronomadopsis*, *Micronomadopsis*, and *Hypomacrotera*. *Perditopasites* has been associated with three subgenera of *Perdita*. An analysis of the relationships of the monophyletic clade to which these panurgines belong with all genera (*Holcopasites, Caenoprosopis, Caenoprosopina, Neolarra,* and *Oreopasites*) of cleptoparasitic bees known to attack it failed to reveal a single case where the same host species supports more than one cleptoparasitic genus. However, different species in *Perdita* are parasitized by *Oreopasites* and *Neolarra*, and different species of *Calliopsis (Hypomacrotera)* are attacked by *Oreopasites* and *Holcopasites*. Although some host species are parasitized by more than one species of *Oreopasites*, there are no known cases where host sharing occurs sympatrically. A number of *Oreopasites* have more than one host.

INTRODUCTION

This is a revision of the genus *Oreopasites* (Ammobatini) consisting of small to minute cleptoparasitic bees restricted to the western part of North America. The genus ranges from the state of Washington to Baja California Sur and eastward to western Nebraska and the Big Bend region of Texas (fig. 9). All of its species attack ground-nesting bees belonging to the specialized New World tribes Calliopsini and Perditini of the Panurginae (Andrenidae). *Oreopasites* adults enter open brood cells of the host while the host females are absent and hide their eggs by inserting them into the cell walls. Upon hatching the hospicidal first instar searches out and kills the host egg or larva and then feeds for the rest of its larval life on the provisions that had been supplied by the host for its young. The 11 recognized species of this parasitic genus are the only known New World members of the Ammobatini (sensu Michener, 1944) which is otherwise restricted to the Palearctic and African regions.

Most individuals are uniformly colored with a dark brown to black head and mesosoma, a red metasoma, and reddish to black legs. They have been rarely collected, probably because of their small size and uniformity of color pattern and because, like most parasitic bees, they do not commonly visit flowers, where most bee collecting is carried out. They can, however, be abundant at times—flying over the surface of the ground at the nesting sites of their hosts.

When Linsley (1941) revised the genus, he found that the interpretation of the species in *Oreopasites* was difficult. With only 125 specimens, he recognized that large *Oreopasites* had larger hosts and small ones tended to have smaller hosts and that the structural differences between parasitic species were often limited. He concluded that the host spe-

cies of *Oreopasites* might influence the anatomical features of their cleptoparasites through the amount and perhaps quality of food (pollen and nectar) they used in provisioning their cells. Although recognizing this to be a potential problem, he had no way to determine the "nature or extent of this influence." I have dealt with this problem by focusing my investigations on extensive collections of *Oreopasites* that have been associated with their hosts.

Fortunately Luisa Ruz undertook a massive, generic-level investigation on the phylogenetic relationships of the Panurginae on a worldwide basis (Ruz, 1987). Part of this investigation (Ruz, 1991) treats that group of specialized, New World panurgines to which all known hosts of *Oreopasites* belong. Her work makes possible the analysis of the host relationships of *Oreopasites* presented in this paper.

Acknowledgments

I especially wish to extend my appreciation to Marjorie Favreau for her years of research assistance on this project in the American Museum of Natural History and at the Southwestern Research Station. I acknowledge with gratitude the efforts in laboratory and/or field of Byron Alexander, Jaun Barberis, Lillian Floge, Ronald J. McGinley, Barbara L. Rozen, and Kenneth C. Rozen. Rose Ismay, Phyllis Browne, Beatrice Brewster, and Deborah J. Hickman have helped in typing and organizing versions of the manuscript.

The resident directors of the Southwestern Research Station, Mont A. Cazier, Vincent D. Roth, and Wade C. Sherbrooke, offered their hospitality and assistance during my stays there. Without the Station as an ongoing base of observations, we would know a lot less about *Oreopasites* and about the biology of bees in general.

Many entomologists made special efforts to collect adults and immatures of these cuckoo bees and their hosts. For this assistance I would like to thank Loren D. Anderson, George E. Bohart, Richard M. Bohart, Mont A. Cazier, the late Paul D. Hurd, Jr., the late J. W. MacSwain, Jerry A. Powell, Roy R. Snelling, Philip F. Torchio, and Marius S. Wasbauer.

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RELATIONSHIPS OF *OREOPASITES* TO OTHER NOMADINAE

From the time of the discovery and description of its first species (Cockerell, 1906), *Oreopasites* was recognized as a cleptoparasitic genus related to genera now placed in the Nomadinae (sensu Roig-Alsina, 1991, and Rozen, 1991, that is, exclusive of Isepeolini,

Protepeolini, Osirini, and *Coelioxoides*). Linsley and Michener (1939) were the first to assign the genus to the Ammobatini, a placement that has been accepted since then. The adult anatomical features that unite the Ammobatini were presented by them and expanded by Michener (1944). Among these features, the following appear to be apomorphies suggesting that the tribe is monophyletic: paraocular area with a thin, rounded carina running along the eye to the lateral apical margin of the clypeus (reduced but evident in *Melanempis*) (also found independently in some Epeolini and most *Nomada*); labrum long compared to breadth (a characteristic that has arisen separately in Holcopasitini, Caenoprosopidini, and Ammobatoidini); unusually long middle coxae; sternum VI of female strongly produced into an attenuate, bifid median process (which, however, is simple in *Pseudodichroa*, Rozen, 1968). To these can be added the clypeal penicillus (brush) of the known males (Alexander, 1990) (except in *Melanempis*).

Immature stages offer few additional synapomorphies for the tribe, but they do not contradict monophyly. Rozen et al. (1978) pointed out that known mature larvae possess a nonspiculated hypopharynx, unlike other Nomadinae except for *Neopasites* and *Neolarra* in which the feature presumably had a separate origin. However, a nonspiculated hypopharynx has now been found in the Caenoprosopidini (Rozen and Roig-Alsina, 1991) and *Townsendiella* (Rozen and McGinley, 1991). This suggests that a reevaluation of the relationships of the larvae might reveal that the feature is a synapomorphy of the Ammobatini, Neolarrini, Biastini, Townsendiellini, and Caenoprosopidini. The paired tubercles on the apicolateral angles of the pupal clypeus of the ammobatines *Oreopasites* and *Morgania* allow for the development of the clypeal penicillus of males (an adult synapomorphy), are found in both males and females, and may be a pupal synapomorphy of the Ammobatini (Rozen and McGinley, 1974). A recently discovered pupa of an undescribed ammobatine genus in the nest of a *Nomioides* from Pakistan also exhibits apicolateral clypeal tubercles. Egg deposition modes of *Pasites* and *Oreopasites* are nearly identical and might represent a tribal synapomorphy because bending and folding of the egg in the host cell wall (Rozen, 1986) is not found elsewhere in the Apoidea.

In addition to *Oreopasites*, the following genera have been included in the Ammobatini: *Ammobates* (including *Xerammobates* and *Euphileremus*[2]), *Parammobatodes, Melanempis, Morgania* (including *Omachthes*), *Pasites, Pasitomachthes, Pseudodichroa*, and *Sphecodopsis* (including *Pseudopasites*) (Grütte, 1935; Michener, 1944). Concluding that the tribe actually consisted of two very different branches, Popov (1951) proposed the tribe Pasitini for *Pasites, Morgania, Pseudopasites, Sphecodopsis, Pasitomachthes*, and *Pseudodichroa* and left *Ammobates, Parammobatodes*, and *Oreopasites* in the Ammobatini. Popov's division of the Ammobatini sensu Michener (1944) has not generally been followed by New World workers, perhaps in part because ammobatine genera are rare, known from only a handful of specimens deposited in a scattering of museums, and in part because all genera except *Oreopasites* are Old World and therefore are not usually encountered by New World specialists.

Whether or not Popov's separation of these two tribes is valid needs further testing. Contrary to Popov's (1951) statements, the male genitalia of *Pasites, Morgania*, and *Sphecodopsis* do not exhibit an almost complete reduction of the gonobases although in *Pasites* and also some (but not all) *Morgania* the gonobase is considerably shortened. Further, only in *Pasites* and some *Morgania* are the penis valves (sagittae) coalesced to an appreciable extent with the penis. In all genera of the Pasitini that I have examined, the gonostyli are well developed rather than completely reduced, as claimed by Popov. However, pasitine gonostyli may not actually bend in relation to the gonocoxites because the thickness of the integument next to the articulating areas is greatly reduced (suggesting a lack of musculature) compared with the heavy sclerotization next to these joints in *Ammobates* and *Oreopasites*.

In support of Popov's hypothesis, the gonocoxites in some Pasitini (*Pasites, Morgania*,

[2] Although *Caesarea* had been tentatively assigned to this group, Popov (1951) thought that it was unrelated.

and *Sphecodopsis*) tend to be elongate although there is apparently considerable variation from the presumably more primitive, shortened gonocoxites to the greatly elongate condition. Also, the gonostyli are wide at their bases and, in dorsal view, their outline appears as a continuation of the gonocoxite. In contrast, the gonocoxites of the ammobatine genera *Ammobates* (figs. 1–4; Popov, 1944, 1951), *Parammobatodes* (Popov, 1931, 1937), *Melanempis* (new information),[3] and some *Oreopasites* (e.g., figs. 22, 75, 83) are short, with the dorsal or ventral outline of the gonostyli appearing as distinct appendages in relation to their gonocoxites. (*Oreopasites arizonica, favreauae,* and *scituli* tend to have elongate gonocoxites, but this is obviously a secondary modification, as discussed in the systematic treatment of *Oreopasites* below.)

Furthermore, in the pasitine genera *Sphecodopsis, Pasites, Morgania*, and *Pseudodichroa* (the male of the latter is unknown), the labrum is generally shorter and in repose its apex does not extend posterior to the closed mandibles (Rozen, 1968: fig. 2). In contrast, in the ammobatine genera *Ammobates, Parammobatodes, Oreopasites*, and *Melanempis*, the labrum is elongate, in all cases extending in repose well posterior to the closed mandibles (figs. 29, 55) which overlap one another as well as the labrum. The shorter pasitine labrum appears to be plesiomorphic because a short labrum is characteristic of most anthophorids. Such a conclusion is tentative, however, because the pasitine labrum is still elongate by comparison with pollen-collecting anthophorids. This elongation is possible because of an angling of the mandible bases, so that in repose the mandibles are directed somewhat posteriorly (Rozen, 1968: fig. 2) rather than pointing transversely toward one another, as tends to be the case with most bees including the Ammobatini sensu Popov. This angling, in conjunction with a somewhat elongate labrum, can be interpreted as a synapomorphy. Hence there may be two synapomorphic conditions of the labrum of the Ammobatini s.l.: (1) elongation of labrum made possible by mandibles overlapping labrum in repose (Ammobatini sensu Popov), and (2) elongation of labrum made possible by mandibles angling posteriorly in repose (Pasitini sensu Popov).

The following list summarizes briefly the synapomorphies discussed above that appear to identify the two divisions of the Ammobatini s.l.:

PASITINI sensu Popov (genera examined *Morgania, Pasites, Pseudodichroa* [male unknown], and *Sphecodopsis*):

1) labrum somewhat elongate;
2) labral elongation made possible by mandibles angling posteriorly in repose;
3) gonocoxite tending to be elongate; and
4) gonocoxite-gonostylus joint weak.

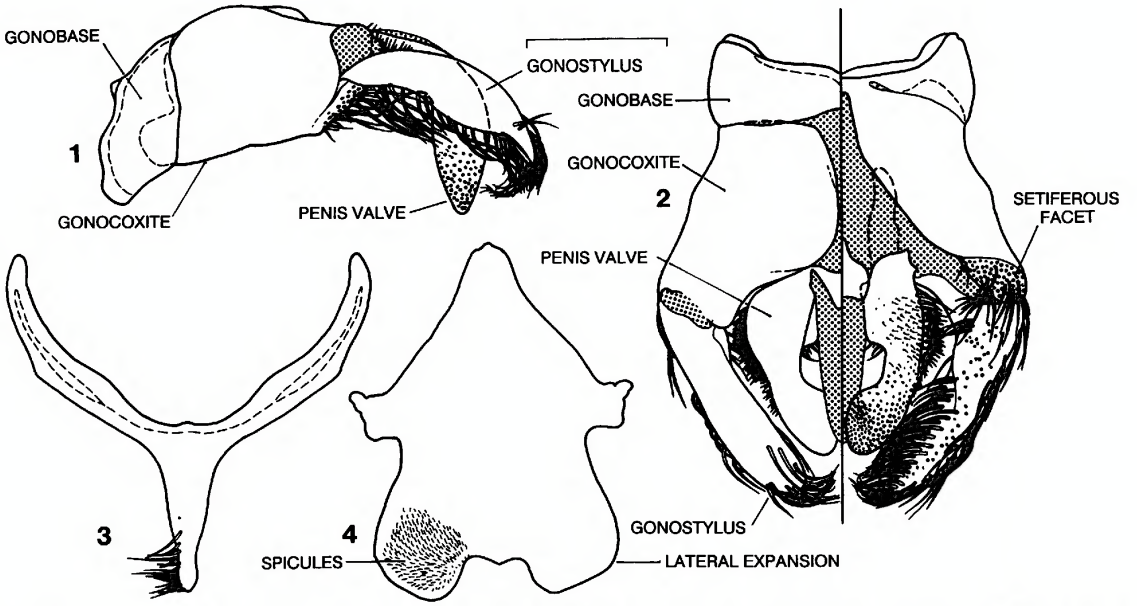
AMMOBATINI sensu Popov (genera examined *Ammobates, Melanempis, Oreopasites*, and *Parammobatodes*):

1) labrum very elongate, more so than in Pasitini; and
2) labral elongation made possible by mandibles transverse in repose, overlapping labrum.

Studies of immature stages have not illuminated the interrelationships within the Ammobatini s.l. (Rozen and McGinley, 1974).

Whether or not the Ammobatini and Pasitini of Popov are each monophyletic might be resolved by a detailed cladistic investigation of all of the included genera as well as by a better understanding of the relationships of the ammobatines to other Nomadinae. For the time being, *Oreopasites* can probably be

[3] Popov (1951) apparently had not seen specimens of *Melanempis* and, therefore, did not assign it to one or the other of the two tribes of the Ammobatini s.l. Through the kindness of Robert Brooks, University of Kansas, I have been able to examine the male genitalia of an unnamed *Melanempis*, so that structures of the male genitalia and subgenital plates can be considered in relation to those of other parasitic genera. The genus can be placed in the Ammobatini sensu Popov because of the following features as well as those described in the text: Its gonocoxites are short, narrow basally, and broad apically when viewed dorsally or ventrally. The gonostyli are distinct from the gonocoxites, although they are unusually broad at the base and possess dense setae on their ventromedial surfaces. The penis valves are elongate, down-curved, and separate from the penis, and metasomal sternum VII is narrowly attenuate apically. Brooks (in prep.) is describing this new species.



Figs. 1–4. *Ammobates carinatus*, male. **1, 2.** Genitalia, lateral, dorsal, and ventral views. **3.** Metasomal sternum VII. **4.** Metasomal sternum VIII. Scale line (= 0.5 mm) refers to figures 1 and 2.

safely regarded as belonging in a clade with *Ammobates*, *Parammobatodes*, and *Melanempis* because of the shared elongate labrum and transversely resting mandibles, and because of similarities of uncertain polarity involving the male genitalia (listed above) and the narrowly attenuate median process of metasomal sternum VII.

GENUS *OREOPASITES* COCKERELL

Oreopasites Cockerell, 1906. Type species: *Oreopasites scituli* Cockerell. Monobasic.

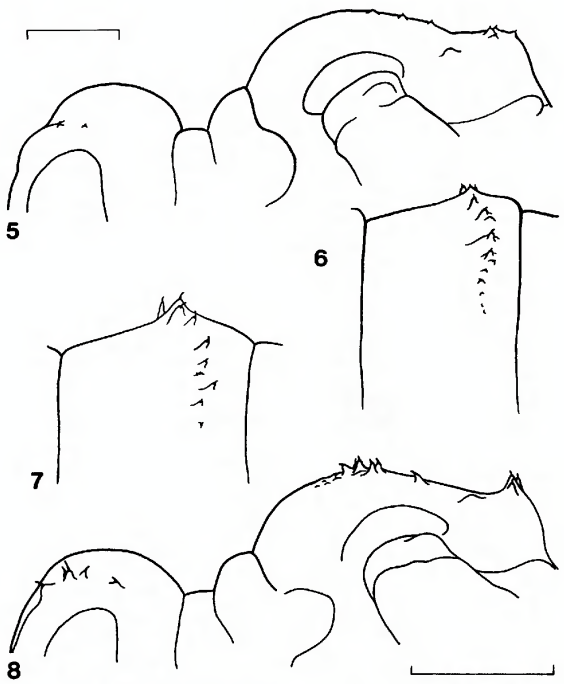
DIAGNOSIS: This genus is the only New World representative the Ammobatini sensu Linsley and Michener (1939) and Michener (1944). For reasons discussed above, it appears to be most closely related to the Palearctic genera *Ammobates* and *Parammobatodes* and to the Madagascan *Melanempis*. *Oreopasites* can be distinguished from the first two genera because metasomal sternum VIII of its male tapers apically (figs. 24, 34, 42, 59, 63) or is parallel sided (figs. 77, 85), and the apical part of the sternum is nonspiculate though it occasionally bears a few setae and scattered weak spicules. In *Ammobates* (fig. 4; Popov, 1951: figs. 6–19) and *Parammobatodes* (Popov, 1931: fig. 7; Popov, 1937: fig. 4) the apex of male sternum VIII is more or less expanded laterally and bears areas of patterned spicules on these lateral expansions.[4] In *Melanempis* the male sternum VIII tapers apically somewhat as in *Oreopasites* but it is much more strongly developed, bears numerous setae and no spicules apically, and does not have a median projection at its base. In *Oreopasites* a distinct occipital carina is present at least near the vertex (except absent in *O. collegarum* and reduced in *O. euphorbiae*) and in the subgenus *Perditopasites* it extends almost to the hypostomal carina, which is also the case for *Melanempis*. In *Ammobates* and *Parammobatodes* that I have examined, this carina is absent or, rarely, indistinct. In these *Ammobates* as well as in *Melanempis*, the posterior, elevated margin of the pronotum is very short, virtually a line at midline, and the strongly bulging anterior edge of the mesoscutum is in line with anterior edge of the pronotal margin. In *Oreopasites* and *Parammobatodes minutus* Mocsàry, the margin, though short, is a distinct

[4] The only exception appears to be *Ammobates mavromoustakisi* Popov (1944: fig. 1C). While sternum VIII is nonspiculate, the apical part is somewhat expanded laterally.

horizontal surface because the anterior edge of the mesoscutum ends behind the anterior edge of the pronotal margin.

Oreopasites was revised earlier by Linsley (1941). Its larvae were described by Rozen (1954) and by Rozen and McGinley (1974). Rozen and McGinley (1974) described the pupae of *O. vanduzeei* and an unnamed species herein described as *O. favreauae*. Figures 5–8 depict their distinguishing features, described but not illustrated at that time. The egg deposition of *Oreopasites* was recorded by Rozen *in* Bohart (1970). Whereas all species of *Oreopasites* are nest parasites of three New World genera of panurgine bees, *Ammobates* attacks species of *Tetralonia*, *Eucera*, and *Anthophora*, and *Parammobatodes* uses the Old World panurgine genus *Camptopoeum* and the halictine genus *Nomioides* as hosts (Popov, 1951). The host of *Melanempis* is suspected to be a large Nomiinae according to Robert Brooks (personal commun.).

Figure 9 shows the geographic distribution of the genus throughout its known range. Figure 10 depicts the microdistribution of the five species found in the vicinity of the Southwestern Research Station near Portal, Cochise Co., Arizona. Table 6 is the temporal distribution of its species and of the host forms of *O. vanduzeei* as revealed by dates of collection.



Figs. 5–8. Pupae of *Oreopasites*. **5**. *O. vanduzeei*, top of head and mesosoma, lateral view. **6**. Same, metasomal tergum III, lateral view. **7**. *O. favreauae*, metasomal tergum III, lateral view. **8**. Top of head and mesosoma, lateral view. Scale lines (= 0.5 mm) refer to figures 5 and 6, and 7 and 8 respectively.

Phylogenetic Relationships of Species

The following cladistic analysis of the species of *Oreopasites* was carried out on a personal computer with James S. Farris' Hennig86 program (Farris, 1988). Characters are explained in table 1. *Ammobates*, *Parammobatodes*, and *Melanempis* appear to be the appropriate outgroup for reasons presented above, but, because so few species of these genera were available for comparisons, *Ammobates carinatus* Morawitz (well represented in the collections of the American Museum of Natural History) was chosen as the specific exemplar. The hypothetical ancestor was modeled on this species; lack of congruency between the ancestor and *A. carinatus* or between the ancestor and other known species of *Ammobates*, *Parammobatodes*, and *Melanempis* is explained as follows (numbers refer to characters in table 1):

0. Most species of *Ammobates* and *Parammobatodes* and all of *Melanempis* are well over 4.4 mm long, the average size of the 11 species of *Oreopasites*. Small size in such species as *A. lebedevi* Popov (Popov, 1951) and *P. gussakovskii* Popov (Popov, 1937) is presumably of independent origin.

1. Most available *Ammobates* and *Melanempis* species, as well as *Parammobatodes minutus* (Mocsáry) possess very short setae on the antennal scape. Longer setae, such as are found in *A. verhoeffii* Mavromoustakis and most species of *Oreopasites*, presumably are independently derived.

2. A distinct occipital carina is missing in *Ammobates* and at least in *Parammobatodes minutus*. Some heavily punctate species of *Ammobates* appear to have an indistinct carina near the vertex, but this vague line is apparently due to a foreshortening of the pits at the rear margin of the head and therefore is not a homolog of the *Oreopasites* occipital

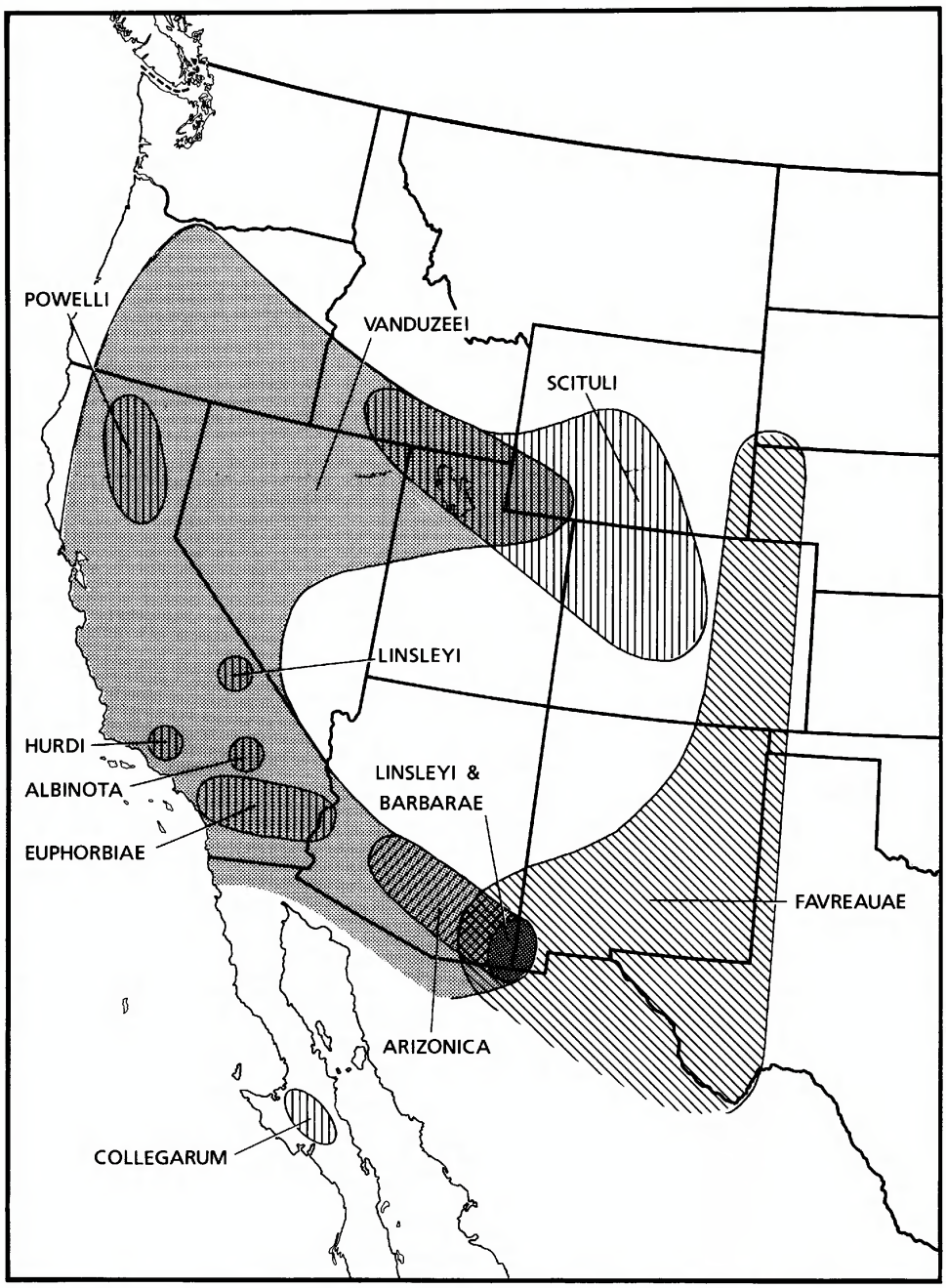


Fig. 9. Composite distribution map of all species of *Oreopasites* in western North America. Subsequent to the preparation of this map, *O. vanduzeei* was found in Benton Co., Washington.

carina. *Melanempis* possesses a well-developed occipital carina.

4. The maximum number of maxillary palpal segments in any ammobatine is six. Because it is unlikely that segments are added during evolution, six is considered plesiomorphic. Independent loss of segments has occurred within *Ammobates, Parammobatodes,* and *Oreopasites*, and *Melanempis* lacks maxillary palpi.

6. The hind wing venation of *Parammobatodes minutus* and apparently *P. gussakovskii* (Popov, 1937) is so reduced and modified that homologies of the veins are unclear.

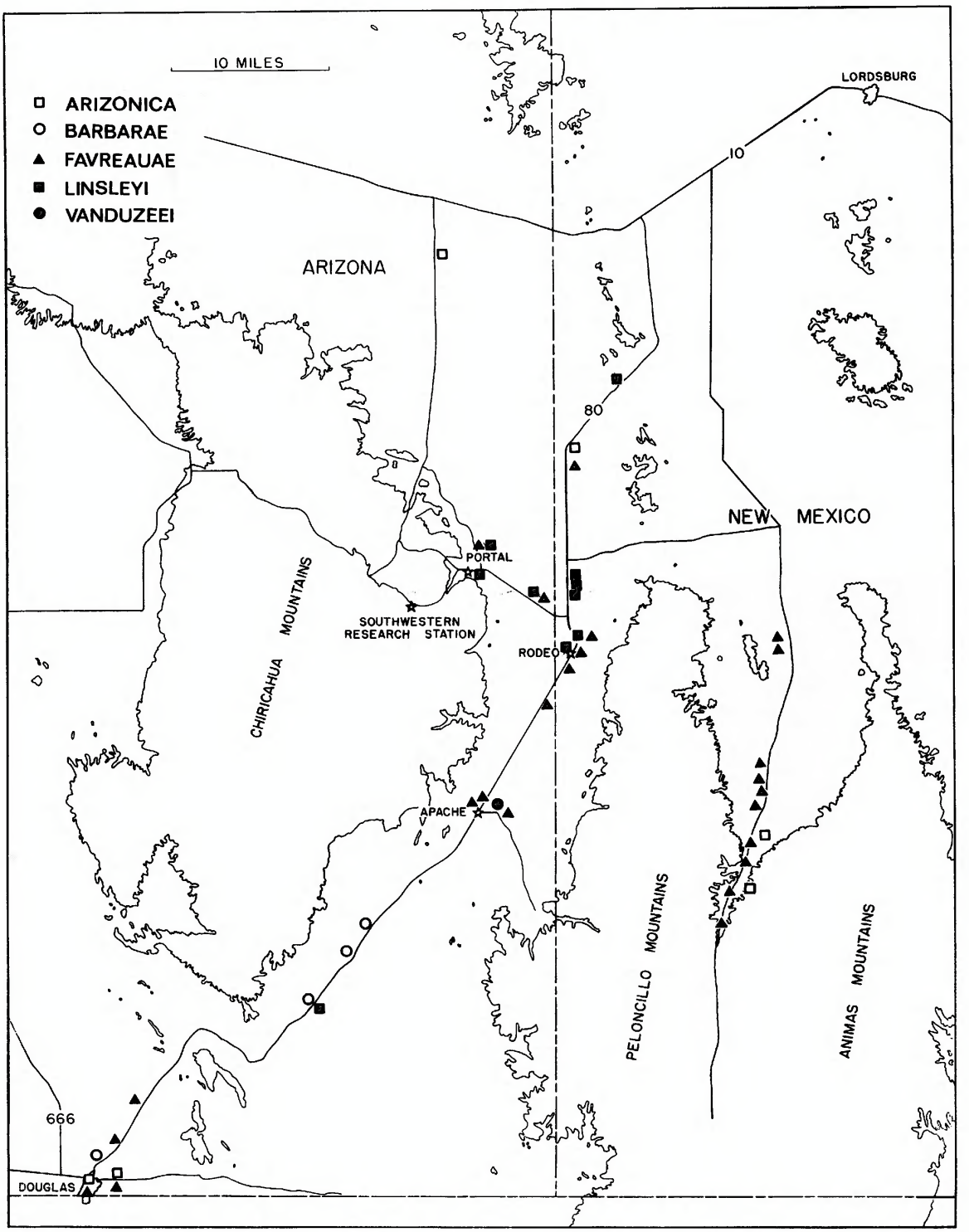


Fig. 10. Distribution of five species of *Oreopasites* found in the vicinity of the Southwestern Research Station, Cochise Co., Arizona.

TABLE 1

Characters Used in Analyzing Relationships of Species of *Oreopasites*

(Coding: 0 = plesiomorphy; 1, 2, etc. = alternative apomorphies. All multistate characters are additive, except for 11 and 12. For further explanation of characters, see text.)

0. Body size: large to medium (average body length > 4.4 mm) (0); small (average body length 3.0–4.4 mm) (1); very small (average body length < 3.0 mm) (2).
1. Antennal scape with setae: extremely short (< 1/4 length of scape) (0); long to very long (about 1/3 to about 1/2 length of scape)[a] (1).
2. Occipital carina: absent (fig. 59) (0); present dorsally but fading out before reaching level of lower margin of eye (figs. 28, 38, 47, 48, 58) (1); present and reaching lower margin of eye (figs. 81, 89) (2).
3. Galeae in repose: extending to base of stipites (fig. 29) (0); not reaching base of stipites (fig. 55) (1).
4. Maxillary palpal segments: 6 (figs. 43, 59) (0); 5 (figs. 58, 67) (1); 4 (2); 2 (3).
5. Labial palpal segments: 4 (figs. 25, 37, 46, 54, 64, 78) (0); 3 (fig. 56) (1).
6. Vein R_s of hind wing: 1.5 to >2× longer than vein r-m (fig. 68) (0); subequal to r-m (fig. 69) (1).
7. Sternum IV of male with much of marginal area: setose (0); glabrous (1).
8. Gonocoxites in ventral view: short, broadening apically, and with ventral, elliptical setiferous facets of outer apical angle transverse (figs. 2, 22, 75, 83) (0); more elongate, broadening little apically and with elliptical setiferous facets oblique (fig. 61) (1); elongate, parallel sided, with elliptical facets even more oblique (figs. 32, 51) (2).
9. Gonocoxites in lateral view: low, about as high as gonobase (figs. 1, 74, 82) (0); high, much more so than gonobase (figs. 21, 31, 39, 50, 60) (1).
10. Penis valves and gonostyli: normally long (e.g., figs. 2, 22) (0); abnormally short (fig. 40) (1).
11. Spinelike setae on outer surface of hind tibia: short, slender, refracting white, scarcely distinguishable (fig. 71) (0); long, slender, refracting white (1); long, stout, refracting white (2); long, stout, refracting amber (fig. 71) (3).
12. Tergum VI of female in lateral view with dorsal surface: gently curving (figs. 79, 87) (0); strongly, evenly curving (figs. 26, 35, 44) (1); bent abruptly (figs. 56, 65) (2).
13. Sternum VI of female: short (e.g., figs. 27, 45) (0); long (fig. 36) (1).

[a] *Oreopasites vanduzeei*, host-form "hesperia" has setae that are only one-fifth the length of the antennal scape. In this respect, this host form is unlike all of the other host forms of the species. The character state is probably a reversal and is therefore ignored in table 2.

The data matrix (table 2) was prepared with the two outgroup taxa (the hypothetical ancestor and *Ammobates carinatus*, figs. 1–4) and 11 *Oreopasites* species. The computations used 11 characters (because characters 5, 10, and 13 are autapomorphies, they were coded inactive). All multistate characters except for 11 and 12 were coded as additive

TABLE 2

Data Matrix for Analysis of Relationships of All Species of *Oreopasites*

(Character codings given in table 1. For explanation, see text.)

	Character													
Taxon	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Ancestor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A. carinatus	0	0	0	0	3	0	0	0	0	0	0	0	0	0
O. vanduzeei	0	1	1	0	0	0	0	0	0	1	0	3	1	0
O. arizonica	0	1	1	0	0	0	0	0	2	1	1	3	1	0
O. favreauae	1	1	1	0	1	0	0	0	1	1	0	2	2	0
O. euphorbiae	1	1	1	1	1	0	0	0	2	1	0	2	2	0
O. collegarum	1	1	0	1	0	0	0	1	1	1	0	2	2	0
O. scituli	0	1	1	0	0	0	0	1	2	1	0	3	1	1
O. hurdi	0	0	1	0	1	0	0	?	?	?	?	3	1	0
O. powelli	1	1	1	0	1	0	0	0	0	1	0	3	1	0
O. albinota	0	1	1	0	?	0	0	?	?	?	?	3	1	0
O. linsleyi	1	0	2	0	1	0	1	0	0	0	0	0	0	0
O. barbarae	2	0	2	0	2	1	1	0	0	0	0	1	0	0

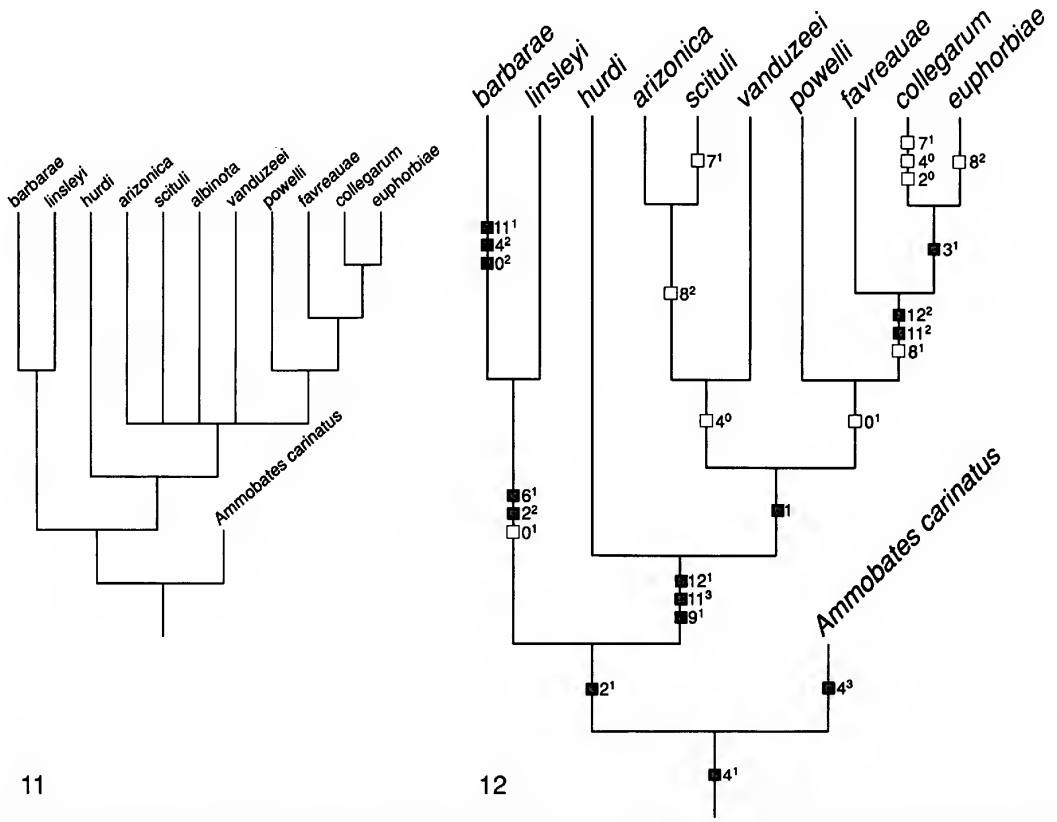


Fig. 11. Nelson consensus tree (length 27, ci 70, ri 78) of the 11 species of *Oreopasites* derived from 7 equally parsimonious trees using the *ie* command of Hennig86. Characters used are presented in table 1, and the matrix is table 2. For further explanation, see text.

Fig. 12. The single most parsimonious tree of all species of *Oreopasites* excluding *O. albinota*. This tree (length 27, 70, ri 78) was produced with the *ie* command of Hennig86. Characters are presented in table 1; the matrix is table 2 (excluding *O. albinota*). Characters 11 and 12 were coded as nonadditive, and autapomorphies (characters 5, 10, and 13) were coded inactive. Solid squares are unique character states; open squares are parallel states, reversal, or both. For further explanation, see text.

because in each the steps appeared to reflect a logical evolutionary sequence (but see below). The steps in characters 11 and 12 could not be so interpreted. When analyzed using the implicit enumeration command (*ie*) of Hennig86, seven equally parsimonious trees were generated (length 27, ci 70, ri 78). A Nelson consensus (fig. 11) of these trees revealed three distinct groups within *Oreopasites*, but a five-branched polychotomy remained unresolved. Because many of the characters of *O. albinota* were coded as "?" (male unknown) and its position varied in the seven trees, the species was deleted from the matrix, and the analysis was again undertaken with the same character codings. The result, generated with the *ie* command, was a single tree (fig. 12) (length 27, ci 70, ri 78) completely resolved for 10 species of *Oreopasites*. This then is the most satisfactory cladogram of the relationships of the species within *Oreopasites* and is the one referred to elsewhere in this paper.

When the program was rerun, this time including *Oreopasites albinota* and excluding *O. hurdi* (another species known only from the female), 17 equally parsimonious trees were produced and a Nelson consensus tree yielded two monophyletic groups of *Oreopasites* and a six-branched polychotomy. As stated in the systematic treatment of *O. albinota*, this species, known only from the type, is nearly identical to *O. vanduzeei* host-form "foleyi" except for a difference in body length

TABLE 3

Hosts and Potential Hosts of Oreopasites

(All species assigned to the *Nomadopsis–Macronomadopsis–Micronomadopsis–Hypomacrotera* clade are confirmed host or are considered potential hosts of *Oreopasites*. Listed species of *Perdita* are confirmed host only. Details of host associations are given in the text, tables 4 and 5, and figures 13–15.)

GENUS *CALLIOPSIS*
- *NOMADOPSIS*
  - *cincta cincta* (Cresson)
  - *cincta hurdi* (Rozen)
  - *comptula* (Cockerell)
  - *edwardsii* (Cresson)
  - *linsleyi* (Rozen)
  - *obscurella* (Cresson)
  - *puellae* (Cockerell)
  - *timberlakei* (Rozen)
  - *zonalis zonalis* (Cresson)
  - *zonalis sierrae* (Rozen)
- *MACRONOMADOPSIS*
  - *anthidia anthidia* (Fowler)
  - *anthidia lutea* (Rozen)
  - *barri* (Rozen)
  - *filiorum* (Rozen)
  - *micheneri* (Rozen)
  - *zebrata zebrata* (Cresson)
  - *zebrata bobbae* (Rozen)
- *MICRONOMADOPSIS*
  - *fracta* (Rozen)
  - *barbata* (Timberlake)
  - *foleyi* (Timberlake)
  - *larreae* (Timberlake)
  - *mellipes* (Timberlake)
  - *phaceliae* (Timberlake)
  - *snellingi* (Rozen)
  - *trifolii* (Timberlake)
  - *helianthi*(Swenk and Cockerell)
  - *beamerorum* (Rozen)
  - *callosa* (Timberlake)
  - *cazieri* (Rozen)
  - *nigromaculata* (Timberlake)
  - *meliloti* (Timberlake)
  - *scutellaris scutellaris* (Fowler)
  - *scutellaris peninsularis* (Cockerell)
  - *australior* (Cockerell)
  - *hesperia hesperia* (Swenk and Cockerell)
  - *hesperia equina* (Cockerell)
  - *macswaini* (Rozen)
  - *personata* (Cockerell)
  - *scitula scitula* (Cresson)
  - *scitula lawae* (Michener)
- UNASSIGNED SPECIES PRESUMABLY BELONGING TO THE *NOMADOPSIS–MACRONOMADOPSIS–MICRONOMADOPSIS* CLADE
  - *boharti* (Rozen)
  - *interrupta* (Provancher)
  - *quadrilineata* (Provancher)
  - *smithi* (Rozen)
  - *solitaria* (Rozen)
  - *xenus* (Rozen)
- *HYPOMACROTERA*
  - *callops* (Cockerell and Porter)
  - *persimilis* (Cockerell)
  - *subalpina* (Cockerell)

GENUS *PERDITA*
- *HEXAPERDITA*
  - *callicerata* Cockerell
- *PERDITA*
  - *obscurella* Timberlake
- *EPIMACROTERA*
  - *biguttata* Timberlake

and therefore is questionably distinct from *O. vanduzeei*.

The program was also rerun (exclusive of *O. albinota*) with all multistate characters coded as nonadditive. It yielded two equally parsimonious cladograms (length 25, ci 76, ri 81). One was identical in topology to figure 12. The arrangement of the species of *Oreopasites* in the second was also identical although this cladogram showed a four-branched polychotomy at the base consisting of (ancestor) + (*A. carinatus*) + (*linsleyi* + *barbarae*) + (all other *Oreopasites*).

Host Associations, Host Specificity, and Effects of Host Evolution

The confirmed or suspected hosts of *Oreopasites* (tables 4 and 5) all belong to a monophyletic group of highly specialized panurgine bees (Andrenidae) restricted to the New World (Ruz, 1987, 1991). Ruz (1991) divided the host group into three tribes, the Protomeliturgini, Calliopsini, and Perditini. *Oreopasites* is restricted to North America, and consequently none of its species are associated with the strictly South American monotypic Protomeliturgini or with the South American taxa of the Calliopsini (*Acamptopoeum, Arhysosage, Spinoliella, Callonychium*, and the South American subgenera of *Calliopsis*) (figs. 13, 14).

Formerly the North American species of the Calliopsini were assigned to three genera, *Calliopsis* (with four subgenera) (revised by Shinn, 1967), *Nomadopsis* (with three subgenera) (revised by Rozen, 1958), and *Hypomacrotera* (consisting of only three spe-

TABLE 4

Hosts of Species of *Oreopasites* other than *O. vanduzeei*

(Only those hosts are listed where the host/*Oreopasites* association is likely. For further explanation, see text.)

Oreopasites sp.	Host sp.	Method of association	Certainty	Source
collegarum	*Mic. nigromaculata*	flying in association	probable (?)	present study
euphorbiae	*Mic. helianthi*	flying in association	highly probable	Linsley, 1941; present study
favreauae	*Mic. helianthi*	immatures collected	near certainty	present study
	Mic. meliloti	flying in association	highly probable	present study
scituli	*Mic. scitula*	immatures reared	certainty	Cockerell, 1906
	Mic. s. scutellaris	immatures collected	near certainty	present study
arizonica	*Hypo. subalpina*	immatures collected	near certainty	Rozen, 1970; present study
barbarae	*Perdita obscurella*	immatures collected	near certainty	present study
	Perdita biguttata	immatures collected	near certainty	present study
linsleyi	*Perdita callicerata*	entering burrows	highly probable	present study

cies). As a result of her cladisitic analysis of the tribe, Ruz (1991) has now placed all of the North American forms into the single genus *Calliopsis* (figs. 13, 14). She regarded *Nomadopsis, Macronomadopsis,* and *Micronomadopsis* as a monophyletic clade within the genus and demonstrated that the former grouping of *Calliopsis* s.s., *Perissander, Calliopsima,* and *Verbenapis* had been paraphyletic. In her classification, all of these taxa have been retained as subgenera, with the addition of *Hypomacrotera*, as yet another North American subgenus. The South American subgenera, which are not relevant to the present investigation of *Oreopasites*, consist of *Liopoeodes, Caeroliopoeum*, and *Liopoeum*. For the purpose of this study, I hereafter (as well as in tables 4 and 5) refer to all of the North American subgenera of *Calliopsis* by their single subgeneric name rather

TABLE 5

Hosts of *Oreopasites vanduzeei*

(Only those hosts are listed where the host/*Oreopasites* association is considered likely. For further explanation, see text.)

Host sp.	Method of association	Certainty	Source
Nomadopsis			
comptula	flying in association	probable	present study
edwardsii	immatures collected	near certainty	present study
obscurella	flying in association	probable	present study
puellae	immatures collected	near certainty	present study
z. sierrae	immatures collected	near certainty	present study
Macronomadopsis			
a. anthidia	immature collected	near certainty	Rozen, 1954; present study
a. lutea	flying in association	probable	present study
Micronomadopsis			
fracta	flying in association	highly probable	present study
barbata	immatures collected	near certainty	present study
foleyi	immatures collected	near certainty	present study
trifolii	flying in association	probable	present study
s. scutellaris	immatures collected	near certainty	present study
h. equina	immatures collected	near certainty	Cockerell, 1925; present study
personata	immatures reared	certainty	present study

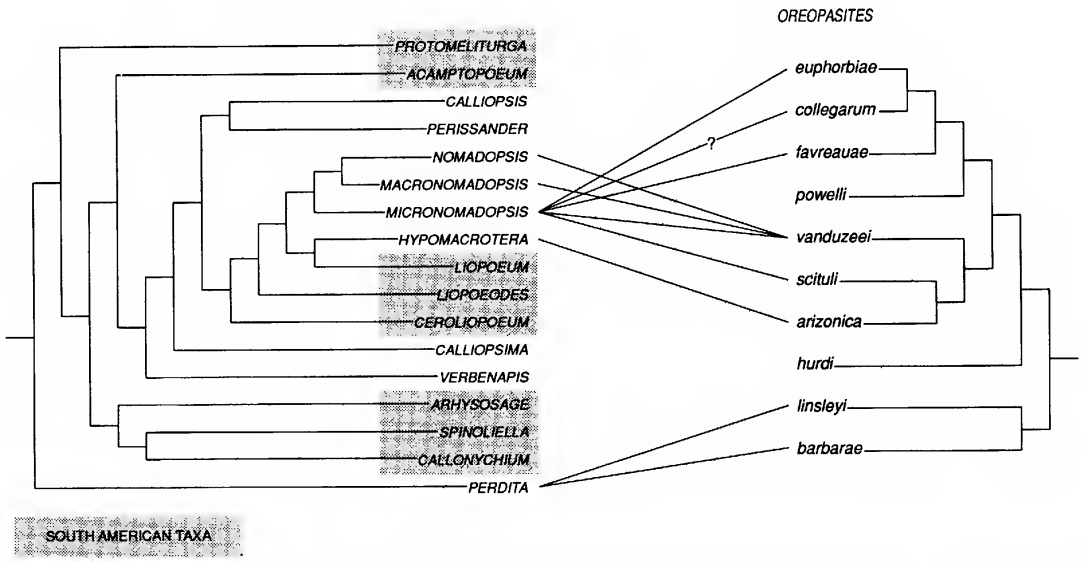


Fig. 13. Comparison cladograms of the species of *Oreopasites* and the genera and subgenera of their hosts, all belonging to a monophyletic specialized group of New World panurgine bees. For further explanation, see text.

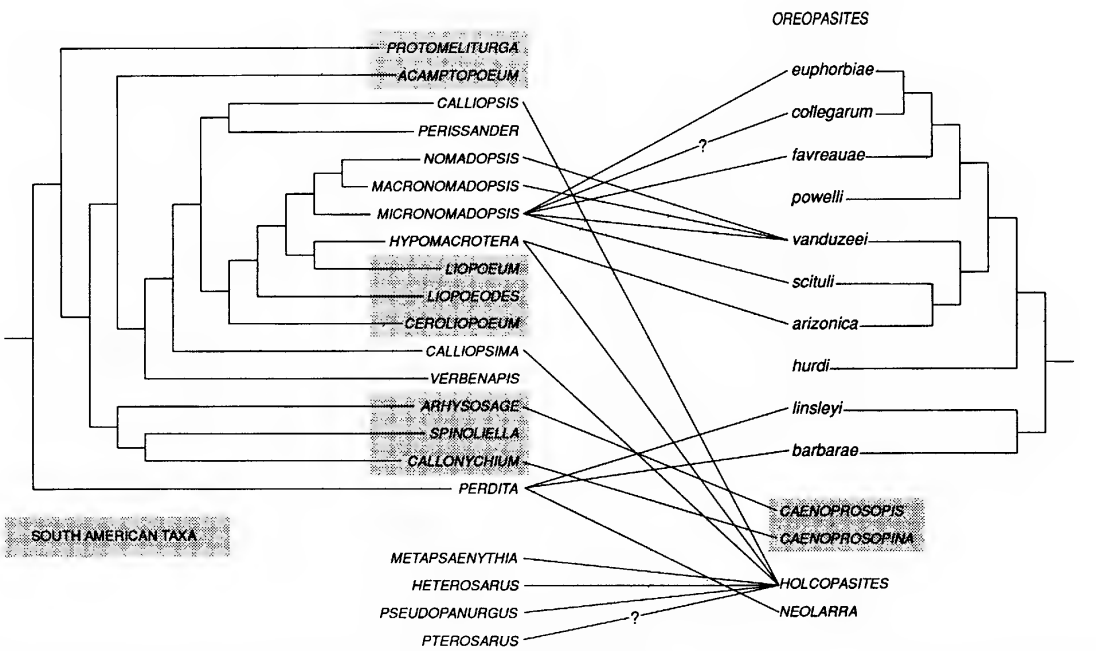


Fig. 14. Comparison cladograms of the species of *Oreopasites* and the genera and subgenera of their hosts (Panurginae), to which has been added the associations of other parasitic anthophorids that attack the same group of panurgine bees as well as some other panurgines (as indicated). For further explanation, see text.

than by the combination of their generic and subgeneric names, to facilitate presentation.

The third tribe of the monophyletic clade, the totally North American Perditini, currently consists solely of *Perdita*, with more than 700 species grouped into 21 subgenera. The genus was actively studied by the late P. H. Timberlake, but the phylogenetic rela-

tionships of its subdivisions require investigation.

All of the species belonging to *Nomadopsis, Macronomadopsis, Micronomadopsis*, and *Hypomacrotera* are either confirmed hosts of *Oreopasites* or at least were considered potential hosts at the beginning of this analysis. The species in these taxa are listed in table 3, as are the three species (belonging to three subgenera) of *Perdita* known to host *Oreopasites* species. Although we can assume that other species of *Perdita* will eventually be identified as hosts of *Oreopasites*, there is no way of estimating which of the more than 700 species might be involved.

Tables 4 and 5 list probable to certain associations of the species of *Oreopasites* and their hosts, derived from: 1) field studies connected with this investigation, 2) information provided by other investigators, 3) coincidence of host/*Oreopasites* capture, and 4) the literature. Obviously some kinds of evidence are more reliable than others, and for that reason these tables indicate the method by which the associations (Method of Association) were made and my estimate as to the reliability (Degree of Certainty) of the association. Rearing adult *Oreopasites* from immatures collected from nests or recovering immatures from nests is highly reliable (certainty or near certainty). Collecting *Oreopasites* flying over nest sites of hosts or entering host nests may be interpreted in various ways (probable, highly probable) depending on the density of the populations at the nesting site and/or the number of nesting sites evaluated. Evaluating the reliability of coincidence of collections of *Oreopasites* and suspected hosts by other entomologist is somewhat more ambiguous, and such data generally were not included in tables 4 and 5. However, in a few cases (*Oreopasites collegarum* and *vanduzeei*, host-form "obscurella"), the collectors (R. R. Snelling and M. Wasbauer, and P. D. Hurd, respectively) were skilled melitologists aware of my interests in *Oreopasites*, so that those associations seem probable.

In some cases, one or more than one potential host was collected with a series of *Oreopasites*. These associations, though not presented in tables 4 and 5, are suggestive of host/parasite relationships and are listed in the systematic treatment of the species of *Oreopasites*, as are all of the probable to certain host associations.

Although considerable progress has been made on identifying host species of *Oreopasites*, the lists in tables 4 and 5 are clearly incomplete. I have no doubt that other host species will be discovered among these specialized panurgines and that other species of *Oreopasites* will be found to have more than one host species.

Figures 13, 14, and 15 compare the associations of *Oreopasites* with their hosts or potential hosts and with other genera of cleptoparasitic anthophorid bees known to attack this clade of specialized panurgine bees. Figure 13 shows the probable to certain host associations of the species of *Oreopasites* with the genera (subgenera) in the three panurgines tribes. South American taxa, all of which are beyond the geographic range of *Oreopasites*, are shaded to facilitate interpretation. The host cladogram (from Ruz, 1991) and the cladogram of *Oreopasites* (see section on Phylogenetic Relationships of the Species of *Oreopasites*, above) are included to enable a comparison of topologies.

Figure 14 depicts the other genera of New World nomadine bees in addition to *Oreopasites* associated with hosts in the Panurginae (see Popov, 1951: table 1, for worldwide host information on some tribes of nomadine bees). Associations of *Neolarra* are from Shanks (1977); *Holcopasites* from Hurd and Linsley (1972) and Rozen (1989); and *Caenoprosopis* and *Caenoprosopina* from Rozen and Roig-Alsina (1991).

Figure 15 shows the species of *Oreopasites* in relation to their known host species (and subspecies) and other species (potential hosts) of *Nomadopsis, Macronomadopsis, Micronomadopsis*, and *Hypomacrotera*. The revisions of *Nomadopsis, Macronomadopsis,* and *Micronomadopsis* (Rozen, 1958) and of *Calliopsis, Perissander, Calliopsima*, and *Verbenapis* (Shinn, 1967) were prepared before cladistic methodology had been introduced in the United States. Although cladistic analyses of these species are not available, many of the species groupings within subgenera are probably monophyletic, as indicated below.

In general these figures show that closely related *Oreopasites* species attack related hosts. The obvious exception is *O. arizonica*

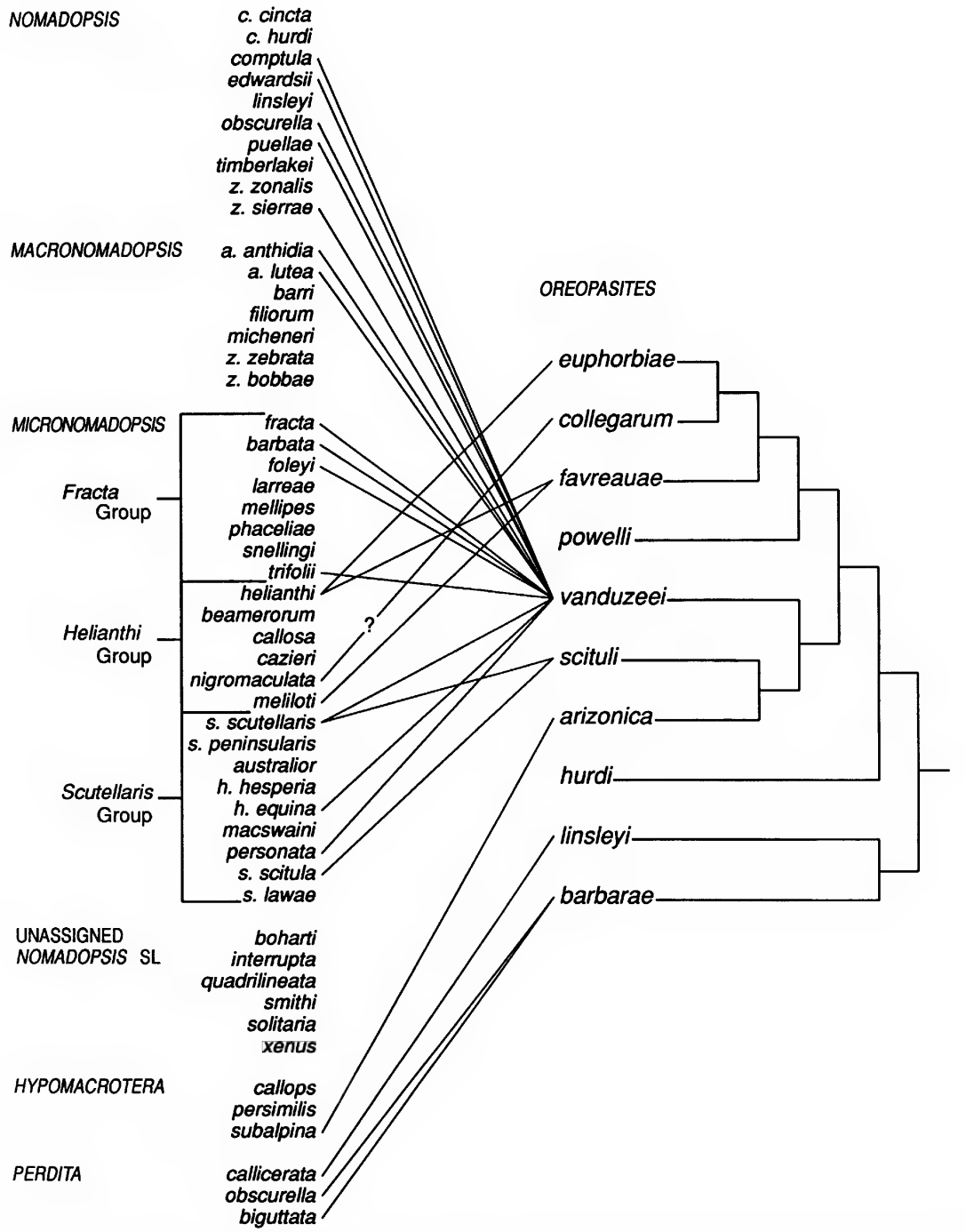


Fig. 15. Comparison of the cladogram of the species of *Oreopasites* with the species groupings of the known and potential hosts. For further explanation, see text.

which appears to have shifted to another host clade unlike its closest relatives, *O. scituli* and *O. vanduzeei*. As Ruz (1991) pointed out, there is "little morphological differentiation" among most of the subgenera of *Calliopsis* s.l. Furthermore, half of the character states separating *Hypomacrotera* and *Micronomadopsis* are reversals. These facts suggest that this part of the host cladogram may be open for reinterpretation, and that this apparent

incongruency between the host and parasite cladograms may be inaccurate.

These three figures illustrate the following: (1) *Oreopasites linsleyi* and *O. barbarae*, constituting the monophyletic subgenus *Perditopasites*, are cleptoparasites of *Perdita*, the sister group to the Protomeliturgini and the Calliopsini combined. All other species of *Oreopasites* whose hosts are known attack nests of species belonging to a monophyletic clade consisting of *Nomadopsis, Macronomadopsis, Micronomadopsis, Hypomacrotera* and the South American *Liopoeum*. *Perdita* and the *Nomadopsis–Macronomadopsis–Micronomadopsis–Hypomacrotera–Liopoeum* clade are quite far apart phylogenetically. (2) *Oreopasites vanduzeei*, the most commonly encountered and most polytypic species in the genus, has by far the widest range of hosts. It attacks the nests of representatives of the monophyletic clade of *Nomadopsis, Macronomadopsis*, and *Micronomadopsis* (including two of the three species groups) and is the only parasitic bee known to be associated with the first two subgenera. (3) *Oreopasites arizonica* is restricted to *Hypomacrotera subalpina*. As discussed above, this association seems incongruent with the fact that its sister species *O. scituli* as well as all other species of *Oreopasites* s.s. are restricted to the *Nomadopsis–Macronomadopsis–Micronomadopsis* clade. (4) *Oreopasites scituli* parasitizes *Micronomadopsis scutellaris scutellaris* and *Mic. scitula scitula*, members of the *Scutellaris* group which, because of a number of synapomorphies, is almost certainly monophyletic. This cuckoo bee has not been recorded yet as a parasite of *Mic. personata*, the only other member of the species group within its geographic range. (5) At the present time the *collegarum–euphorbiae–favreauae* clade of *Oreopasites* appears to be restricted to the *Helianthi* group of *Micronomadopsis*, to the exclusion of all other *Oreopasites* species. This group, with the possible exception of *Mic. beamerorum* and *Mic. callosa*, is thought to be monophyletic. Further investigation may reveal that the *collegarum–euphorbiae–favreauae* clade has a wider range of hosts, however.

Figures 13, 14, and 15 raise a number of questions concerning host/parasite relations. To what extent do the species of *Oreopasites* have more than one host? Obviously, *O. vanduzeei* has many, but other species also have more than one: *O. favreauae, O. scituli*, and *O. barbarae*. How many host species encounter more than one species of *Oreopasites*? *Micronomadopsis helianthi* supports both *O. euphorbiae* and *O. favreauae* but in different parts of its range. *Micronomadopsis scutellaris scutellaris* hosts *O. scituli* and *O. vanduzeei* in the same general geographic area, but lack of coincidence of collection data suggests that the two parasitic species are microgeographically separated.

Is there evidence to suggest that all North American members of the *Nomadopsis–Macronomadopsis–Micronomadopsis–Hypomacrotera* clade of the Calliopsini may be potential hosts of *Oreopasites*, and that these associations simply have not yet been observed? Although many more host/parasite associations will undoubtedly be forthcoming, Rozen (1958, 1963, 1970) discussed nesting sites of substantial size where no *Oreopasites* were present. Some of these sites may not have been utilized by *Oreopasites* because they had not yet been found, they were outside the range of the *Oreopasites*, or the ecological conditions at the nesting might not have been suitable for *Oreopasites* (e.g., the nesting site of *Mac. micheneri* in an actively used bridle path; Rozen, 1958). However, some species in the clade of potential hosts simply may not be attacked by any species of *Oreopasites*. Most *Perdita* are not potential hosts of *Perditopasites*. Many nesting sites of *Perdita* have been discovered without evidence of these parasites. Furthermore, *Perditopasites* is extremely rare even in well-studied localities with a dense *Perdita* fauna such as Cochise County, Arizona, which has approximately 100 species of *Perdita*.

Although the South American panurgines are allopatric with *Oreopasites*, one must ponder why *Oreopasites* has not been found attacking *Calliopsis* s.s., *Perissander, Calliopsima*, and *Verbenapis*, all of which occur within the known range of these cuckoo bees. The answer does not seem to rest in the ecology of the nesting sites, host-nest architecture, or nature of the provisions since these features in at least *Calliopsis* s.s. and *Calliopsima* cannot be differentiated from those of the host taxa-20(Shinn, 1967; Rozen, 1967,

1970; Rust, 1988). Indeed all of the calliopsine genera (both North and South American) are quite similar with regard to these biological attributes.

The hosts of both *Oreopasites powelli* and *O. hurdi* remain unknown. The comparison cladograms (figs. 13–15) suggest that *O. powelli* attacks nests of the *Nomadopsis–Macronomadopsis–Micronomadopsis* clade, most likely those of a *Micronomadopsis* (because only *O. vanduzeei* parasitizes other subgenera), and possibly a species in the *Helianthi* group (only known hosts of its sister group). However, no species of the *Helianthi* group is known to occur in the geographic range of *O. powelli*. An alternative acceptable hypothesis is that one of the unassigned species of the *Nomadopsis–Macronomadopsis–Micronomadopsis* clade hosts this species since the phylogenetic relationships of these species are obscure. (Nesting sites of the unassigned species are unknown.) The host of *O. hurdi*, the sister species of all *Oreopasites* s.s., is almost impossible to predict from these cladograms. One can assume that its host might be any species in the Calliopsini or Perditini within geographic range.

Figure 14 compares the monophyletic clade to which these panurgines belong with all genera (*Holcopasites, Caenoprosopis, Caenoprosopina, Neolarra*, and *Oreopasites*) of cleptoparasitic bees known to attack it. *Hypomacrotera* is attacked by both *Oreopasites* and *Holcopasites*, and *Perdita* is parasitized by *Oreopasites* and *Neolarra*. However there is no instance in either *Hypomacrotera* or *Perdita* where the same host species supports more than one cleptoparasitic genus. Whereas this is not surprising for *Perdita* because so few species of *Perdita* are known hosts of *Oreopasites*, the lack of overlap of hosts in *Oreopasites* and *Holcopasites* cannot be easily explained.

Key to Species

1. Males; flagellomeres 11 2
   Females; flagellomeres 10 10
2(1). Maxillary palpus six-segmented (including minute basal segment) (figs. 43, 59) 3
   Maxillary palpus four or five-segmented (including minute basal segment) (figs. 58, 67) 6
3(2). Mesoscutum evenly and moderately densely punctate throughout; gonocoxites wider apically than gonobase (fig. 22); metasomal sternum IV with numerous setae arising from marginal area. Body length 3.5–6.6 mm. California, Oregon, Idaho, Wyoming, Nevada, Arizona ..... *vanduzeei* Cockerell
   Mesoscutum with discal area on either side of midline less heavily punctate than marginal areas and midline; gonocoxites and gonobase about equal in width (figs. 32, 40); metasomal sternum IV with margin glabrous or with setae arising only from basal areas so that apical region shiny, impunctate 4
4(3). Metasoma at most with terga VI and VII darkly pigmented, other terga red; body larger (length 5.9–6.25 mm); metasomal sternum IV usually with basal part of marginal area bearing numerous setae ..... *arizonica* Linsley
   Metasoma with extensive dark pigmentation so that at least terga V–VII infuscated; body smaller (length 3.1–5.5 mm); metasomal sternum IV usually with almost all of marginal area glabrous 5
5(4). Galea short, measured from insertion of palpus to apex, about one-half length of eye, and in repose completely covered by labrum; body small (3.1–4.2 mm); known only from Baja California Sur (fig. 49) ..... *collegarum*, n. sp.
   Galea long, subequal to eye length, and in repose with apex protruding from under labrum; body larger (4.9–5.5 mm); known from Idaho, Utah, Wyoming, and Colorado (fig. 30) ..... *scituli* Cockerell
6(2). Spinelike setae on outer surface of middle tibia refracting amber; setae on mesoscutum amber; scape, exclusive of basal ball, shorter than first three flagellomeres together, little longer than first two subsegments; known from northern California (fig. 30). Body length 3.2–3.75 mm ..... *powelli*, n. sp.
   Spinelike setae on outer surface of middle tibia usually refracting white; if faintly yellow, then setae on mesoscutum glistening white; scape, exclusive of basal ball, subequal in length to first three flagellomeres together; known from southern California, Arizona, New Mexico (figs. 49, 72) 7
7(6). Mesoscutum with short, strongly plumose, glistening white, recumbent setae

in addition to longer, less plumose suberect setae; hence pilosity appearing shaggy, particularly as seen in profile; posterior margin of compound eye, as seen in lateral view (figs. 58, 67), in line with lateral ocellus; metasomal tergum IV with marginal hair band conspicuous, being composed of dense, strongly plumose setae that completely obscure integument except along median line; hosts *Micronomadopsis helianthi* and perhaps *nigromaculata* and *hesperia* 8

Mesoscutum with all setae short, of uniform length and semirecumbent, giving pilosity a uniform appearance; posterior margin of compound eye in front of lateral ocellus, as seen in figures 81, 89; metasomal tergum IV with marginal hair band less conspicuous or virtually absent, so as never to obscure most of integument; hosts *Perdita* species 9

8(7). Mouthparts short so that in repose galea extending less than halfway between labral apex and base of stipes (fig. 55); metasoma usually red throughout, rarely with tip infuscated; known only from southern California (fig. 49). Body length 3.0–4.0 mm ... *euphorbiae* Cockerell

Mouthparts longer, so that in repose galea extending or nearly extending to base of stipes; metasoma normally with apical segments conspicuously infuscated; known from Arizona to Texas to Nebraska (fig. 49). Body length 3.2–4.25 mm ..... *favreauae*, n. sp.

9(7). Maxillary palpus five-segmented; labial palpus four-segmented (fig. 78); body length 3.4–4.75 mm. Arizona, New Mexico, and southern California (fig. 72) ..... *linsleyi*, n. sp.

Maxillary palpus four-segmented; labial palpus three-segmented (fig. 56); body length 2.2–3.1 mm. Arizona, New Mexico (fig. 72) ..... *barbarae*, n. sp.

10(1). Metasomal sternum III with marginal area pubescent (figs. 18, 19), at least anteriorly 11

Metasomal sternum III with marginal area glabrous (fig. 17), or with at most a few scattered setae (fig. 16) 14

11(10). Metasomal sternum IV without setae arising from posterior half of marginal area (fig. 18); most setae on anterior surface of middle and hind femora erect; maxillary palpus six-segmented (including minute basal segment). Body length 5.25–6.75 mm. Southern Arizona, New Mexico (fig. 30) ... *arizonica* Linsley

Metasomal sternum IV with numerous setae arising from posterior half of marginal area (fig. 19); most setae on middle and hind femora recumbent; maxillary palpus four- to five-segmented (including minute basal segment) 12

12(11). Metasoma reddish brown basally, grading to dark brown apically; body extremely small (length less than 3.0 mm) and slender; labial palpus three-segmented (fig. 56). Arizona, New Mexico (fig. 72) ..... *barbarae*, n. sp.

Metasoma either completely red or at most with segments IV–VI somewhat darkened; body small (length 3.5 mm) to moderate in size; labial palpus four-segmented (fig. 78) 13

13(12). Maxillary palpi elongate and postgenal setae short, so that palpi more than twice as long as longest setae; body longer (4.9 mm) and more robust. Southern California (fig. 30) ..... *hurdi*, n. sp.

Maxillary palpi short and postgenal setae moderately long, so that palpi at most slightly longer than longest setae; body shorter (less than 4.3 mm) and more slender. Southern California, Arizona, New Mexico (fig. 72) .. *linsleyi*, n. sp.

14(10). Metasomal sternum V with subapical hair collar composed partly or entirely of long setae which reach or nearly reach posterior edge of segment (fig. 17).. 15

Metasomal sternum V with subapical hair collar composed solely of very short setae that do not reach posterior edge of segment (fig. 16) 18

15(14). Setae laterad of lateral ocellus grayer and much less plumose than those between antennal socket and inner orbit; posterior metasomal terga darker than anterior ones; maxillary palpus six-segmented. Body length 4.3–5.3 mm. Idaho, Utah, Wyoming, Colorado (fig. 30) ..... *scituli* Cockerell

Setae laterad of lateral ocellus snow-white, essentially same as, though sparser than, those between antennal socket and inner orbit; metasomal terga reddish throughout; maxillary palpus five or six-segmented 16

16(15). Mouthparts long, so that in repose galea extending to base of stipes (as in fig. 29); last two segments of labial palpus (fig. 64) combined about two-thirds length of second segment. Body length 3.0–4.75 mm. Arizona, New Mexico, Texas, to Nebraska (fig. 49) ..... *favreauae*, n. sp.

Mouthparts short, so that in repose galea extending at most halfway between labral apex and base of stipes (fig. 54); last two segments of labial palpus combined slightly longer than, or subequal to, second segment 17

17(16). Maxillary palpus six-segmented (including small basal segment) (fig. 59); galea (fig. 59) extremely short, so that measured from insertion of palpus to apex, about one-half maximum eye length; vertex and mesoscutum very dark brown to nearly black; known only from Baja California Sur (fig. 49). Body length 2.9–4.2 mm ..... *collegarum*, n. sp.

Maxillary palpus five-segmented (fig. 58); galea (fig. 58) longer, about two-thirds maximum eye length; vertex and mesoscutum usually much paler; known from southern California (fig. 49). Body length 3.4–4.25 mm .... *euphorbiae* Cockerell

18(14). Maxillary palpus with four or five very short segments; subapical hair collar on metasomal sternum V broadly interrupted medially; body small (length 2.8–3.45 mm). Northern California (fig. 30) ..... *powelli*, n. sp.

Maxillary palpus six-segmented[5] (including minute basal segment); subapical hair collar on metasomal sternum V complete, briefly interrupted (fig. 16), or rarely broadly interrupted medially; body small to large (length 3.2–7.4 mm). California, Oregon, Idaho, Wyoming, Nevada, Arizona (figs. 20, 30) 19

19(18). Mesoscutum nearly completely obscured by white, very plumose recumbent setae; body large (length 5.5 mm). Southern California (fig. 30) .... *albinota* Linsley

Mesoscutum usually with sparser recumbent setae so that much of integument visible; these setae usually less plumose and often amberish; if setae strongly plumose, white, and obscuring integument (as in *O. vanduzeei* host form *foleyi*), then body small (length 3.4–4.2 mm). California, Oregon, Idaho, Wyoming, Nevada, Arizona (fig. 20) .... *vanduzeei* Cockerell

Subgenus *Oreopasites* Cockerell

Diagnosis: Species of this subgenus can be differentiated from those in *Perditopasites*, new subgenus, by the characters presented in the treatment of the latter. *Oreopasites* s.s. attacks the nests of certain species of *Calliopsis* subgenera *Nomadopsis, Macronomadopsis, Micronomadopsis,* and *Hypomacrotera*.

[5] The number of maxillary palpal segments of *O. albinota* is unknown, but, because the segments are long, the palpus is presumed to be six-segmented.

Oreopasites vanduzeei Cockerell

Figures 16, 20–29, 70

Oreopasites vanduzeei Cockerell, 1925: 202 (type female, in collection of California Academy of Sciences).

Oreopasites vanduzeei diabloensis Linsley, 1941: 315 (type male, in collection of Academy of Natural Sciences of Philadelphia, no. 8220). NEW SYNONYMY.

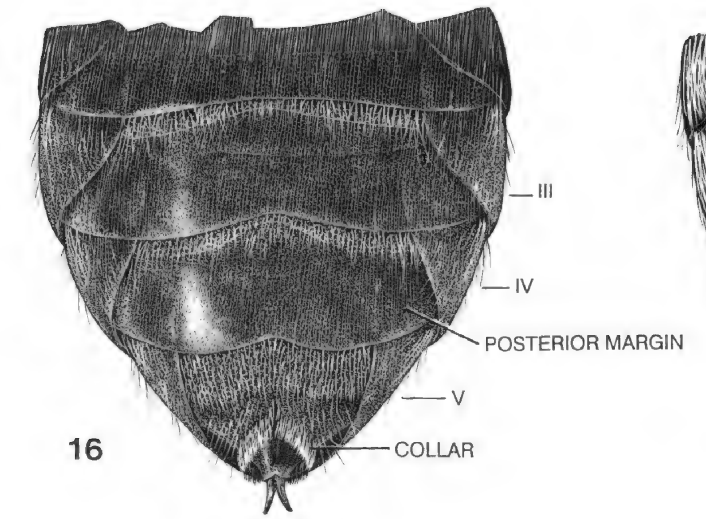
Oreopasites vanduzeei melanantha Linsley, 1941: 316 (type female, in collection of the Academy of Natural Sciences of Philadelphia, no. 8221). NEW SYNONYMY.

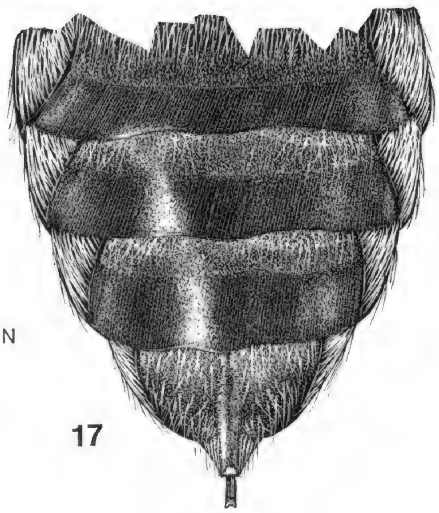
Oreopasites vanduzeei vernalis Linsley, 1941: 317 (type female, in collection of Academy of Natural Sciences of Philadelphia, no. 8222). NEW SYNONYMY.

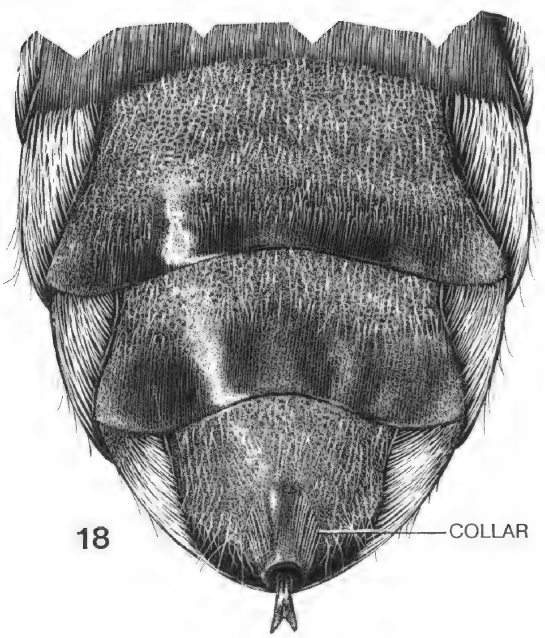
Oreopasites vanduzeei xerophila Linsley, 1941: 318 (type female, in collection of P. H. Timberlake, deposited in the California Academy of Sciences). NEW SYNONYMY.

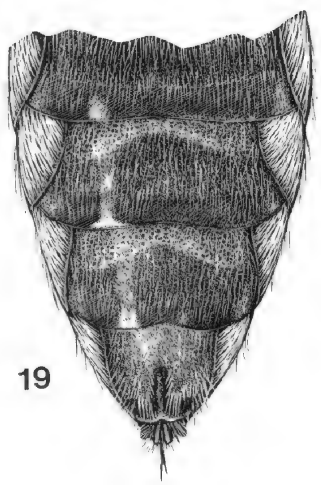
Diagnosis: This is the most commonly collected species of *Oreopasites* and seems particularly abundant in California, where most of its host species occur. Although it varies in size, expression of red integumental coloration, and color and plumosity of setae, characters presented in the key should permit identification of both sexes. In addition, the clypeus (fig. 28) tends to be longer and more protuberant than in other species except for *O. hurdi* and *O. powelli*.

Description: *Female*. Body length 3.2–7.4 mm; length of forewing, measured from tip of costal sclerite to apex, 2.4–4.6 mm. **Head**: Integumental background color of vertex dark brown to black, labrum pale reddish brown to dark brown, concolorous with or darker than background color of metasoma. Setae between lateral ocellus and eye white to distinctly amberish, as plumose as, to much less plumose than, those between antennal socket and eye; setae on antennal scape moderately short to moderately long, but longer than those of *Oreopasites hurdi*. Inner orbits converging below; clypeus long, longer than that of *O. linsleyi, O. barbarae, O. favreauae, O. arizonica*, and *O. scituli*; clypeus also more







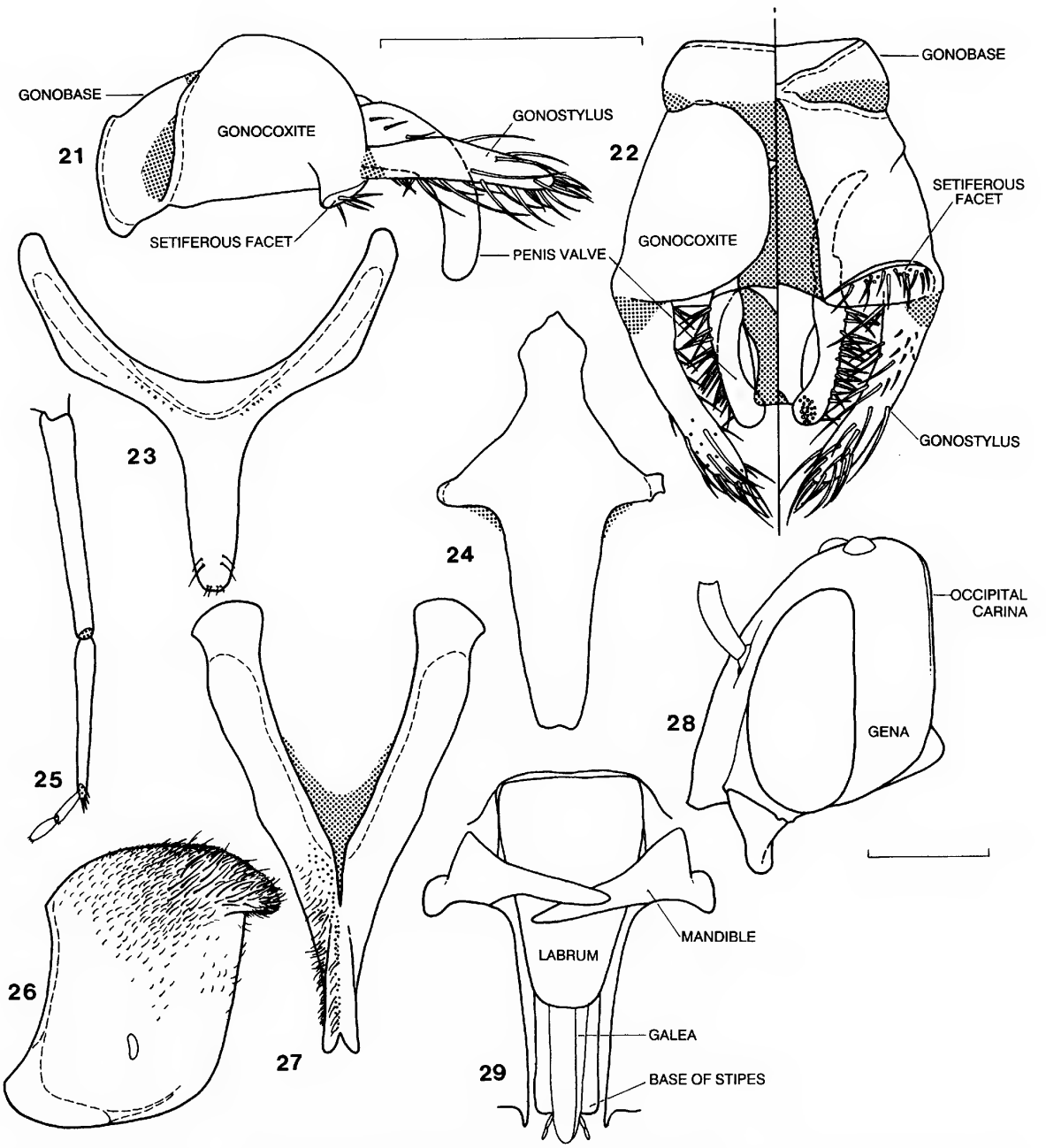


Figs. 16–19. Apex of female metasoma of four species of *Oreopasites*, ventral view. **16**. *O. vanduzeei*. **17**. *O. scituli*. **18**. *O. arizonica*. **19**. *O. linsleyi*. Drawn to various scales.

protuberant than in those species, about same as in *O. hurdi*; gena (fig. 28) wide; occipital carina distinct above, fading out about halfway down posterior margin of gena as seen in lateral view (fig. 28). Scape exclusive of basal ball and combined first three flagellomeres, subequal in length. Mouthparts long so that in repose galeae extending to base of stipites; maxillary palpus six-segmented. Galea, apicad of palpal insertion, longer than maximum eye length in lateral view. Labial palpus (fig. 25) four-segmented, with approximate ratio of segments 1/2/3+4:1.3–1.7/1.0/0.3–0.5. **Mesosoma**: Mesoscutum dark brown to black; mesoscutellum tending to be concolorous with scutum or slightly paler; pleural regions concolorous with, to paler than, scutum. Recumbent setae on mesoscutum

Fig. 20. Distribution of *Oreopasites vanduzeei.*

amberish to snowy white; discal setae on mesoscutum of unworn specimens dense and rather long, and varying from being nonplumose (or inconspicuously plumose) and amberish to being plumose and glistening white; mesoscutal disk shiny between moderately dense punctures that tend to be evenly spaced. Forewing with distal end of marginal cell gradually curving from wing margin, to obliquely subtruncate, to nearly truncate; vein 2nd m-cu joining M basad of junction of second r-m and M; hind wing (fig. 70) with veins R_s approximately twice as long as r-m. Hind femora concolorous with to much darker than red background color of metasoma; suberect spinelike setae on outer surface of middle and hind tibiae moderately long and stout, refracting amber, hence distinct from appressed setae. **Metasoma**: Integumental color pale reddish to reddish throughout, to having marginal areas distinctly infuscated so that metasomal apex medium brown. Dorsal marginal bands of plumose setae conspicuous to inconspicuous, varying in density and degree of distribution of setae. Tergum VI (fig. 26), as seen in lateral view, with dorsal surface evenly curved. Sterna III and IV (fig. 16) each with marginal area glabrous; sternum V (fig. 16) with subapical hair collar forming shallow to deep inverted "V"; collar con-



Figs. 21–29. *Oreopasites vanduzeei*. **21**, **22**. Male genitalia, lateral, dorsal, and ventral views. **23**. Male metasomal sternum VII, ventral view. **24**. Male metasomal sternum VIII, ventral view. **25**. Labial palpus. **26**. Female metasomal tergum VI, lateral view. **27**. Female metasomal sternum VI, ventral view. **28**. Female head, lateral view. **29**. Proboscidial fossa, ventral view, showing mouthparts in repose. Scale lines (= 0.5 mm) refer to figures 21 and 22, and 28 respectively.

sisting solely of short setae; sternum VI (fig. 27) distinctly shorter than that of *O. scituli*.

Male. Body length 3.5–6.6 mm; length of forewing measured from tip of costal sclerite to apex 2.4–4.1 mm. **Head**: Integumental background color of vertex very dark brown to black; labrum medium reddish brown to nearly black, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish or white, either

less plumose than or as plumose as setae between antennal socket and eye; setae on antennal scape considerably longer than those of female. Remaining parts of head as described for female. **Mesosoma**: As described for female except integumental color very dark brown to black, often tending to be darker than that of female, and color of legs dark brown to very dark brown, tending to be darker than that of female. **Metasoma**: Integumental color variable from being completely reddish to completely dark brown, but most often with basal terga reddish and apical terga darker. Sternum IV with marginal area usually setose but sometimes glabrous apically; sternum VII (fig. 23) with median process narrowly rounded; sternum VIII (fig. 24) with median process narrow and elongate; gonocoxites as seen in ventral view (fig. 22), broad apically, similar to those of *O. linsleyi* and *O. barbarae*; gonocoxites in lateral view (fig. 21) high, higher than gonobase.

REMARKS: *Oreopasites vanduzeei* is the most commonly encountered and most widely distributed (fig. 20) species in the genus and shows substantial anatomical variation. When Linsley (1941) revised the genus, variants seemed to be correlated with the particular species of *Nomadopsis, Macronomadopsis,* or *Micronomadopsis* known or thought to be its hosts, and he described and named the host-related populations as subspecies.

Many more specimens of *Oreopasites vanduzeei* have been collected since 1941, and some are associated with still other hosts. From this mass of new material, three observations emerge: (1) Samples (perhaps with the exception of those from the wide-ranging *Micronomadopsis scutellaris*) associated with a single host tend to be homogeneous as suggested by Linsley's (1941) treatment. (2) Despite the homogeneity of the samples, the differences between one host form and another are often difficult to perceive because many more host forms are known now than in 1941. Hence, the distinctiveness among some host forms is questionable. (3) Among all host forms, there are no consistent behavioral characterisitics, detectable ecological preferences, or solid structural differences such as in male genitalia, mouthparts, or other features of demonstrated taxonomic value elsewhere in the genus. Consequently, *Oreopasites vanduzeei* appears to be a single, variable species associated with many different hosts, which apparently always belong to *Nomadopsis, Macronomadopsis,* or *Micronomadopsis*. Specimens associated with small-sized hosts are small, whereas those associated with larger hosts tend to be larger, although their size does not correspond directly to the much larger body forms of some of the hosts, such as *Macronomadopsis anthidia*.

The subspecies designated by Linsley (1941) are here regarded as "host varieties" rather than as subspecies, as he had perceived might happen. They are synonymized with *Oreopasites vanduzeei*, both because host-associated samples are in some cases indistinguishable from one another and because they are not geographically definable.

If one ignores all host associations, the following overview of the geographic variation of *Oreopasites vanduzeei* emerges, exclusive of body size which is correlated with host size. Specimens from southern California, the San Joaquin and Sacramento Valleys of California, and the desert regions of Arizona tend to have less extensive dark pigmentation (i.e., more extensive red coloration), especially on the male metasoma, whereas specimens from the Sierra Nevada, northern California, Oregon, and Utah often have more extensive dark pigmentation on the metasoma. Marginal hair bands on the metasomal terga tend to be more conspicuous (because either the setae are more plumose or are more extensive) on specimens from Idaho, Utah, Arizona, and the desert regions of southern California, in contrast to specimens from elsewhere in California and Oregon.

I describe below the various host-associated samples of *Oreopasites vanduzeei* to give the reader an understanding of the variation within and between samples. Whether or not these samples represent genetically definable populations is not always clear. In some cases, the differences in samples apparently can be explained on the basis of quantity of food supplied by different sizes of hosts. However, this is not always the case; although quantity of larval food can explain size differences, it cannot account for differenses in hair color or plumosity.

These forms are identified by the names of their *Nomadopsis, Macronomadopsis*, and

Micronomadopsis hosts. The only exception is *Oreopasites vanduzeei* host-form "scutellaris" that is associated with two species of *Micronomadopsis (s. scutellaris* and *personata).* In these cases the *Oreopasites* samples were so similar and so small that separate descriptions seemed unnecessary.

The distribution of the host form is given in each case, and the final section treats the geographic and temporal distribution of specimens of *O. vanduzeei* not associated with hosts.

Oreopasites vanduzeei, host-form "hesperia"

DESCRIPTION: *Female.* Body length 3.7–5.0 mm; length of forewing measured from tip of costal sclerite to apex 3.1–3.7 mm. **Head**: Integumental background color of vertex dark brown to black, predominantly very dark brown; labrum pale reddish brown but in most cases reddish brown, approximately concolorous with background color of metasoma. Setae between lateral ocellus and eye white to distinctly amberish, much less plumose than those between antennal socket and eye; setae on antennal scape rather short, longer ones being approximately 1/5 length of scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.4/1.0/0.35. **Mesosoma**: Mesoscutum dark brown to very dark brown, rarely black. Recumbent setae on mesoscutum normally amberish. Forewing with distal end of marginal cell gradually curving from wing margin. Legs tending to be pale so that hind femora concolorous with red background color of metasoma. **Metasoma**: Integumental color pale reddish throughout. Dorsal marginal bands of plumose setae inconspicuous because plumose setae sparse and tending to be restricted to sides of terga; band of tergum IV broadly interrupted medially.

Male. Body length 4.1–4.5 mm; length of forewing measured from tip of costal sclerite to apex 2.8–3.5 mm. **Head**: Integumental background color of vertex very dark brown to black; labrum very dark brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish or perhaps in some cases white, normally less plumose than setae between antennal socket and eye; setae on antennal scape considerably longer than those of female. **Mesosoma**: As described for female except integumental color very dark brown to black, distinctly darker than that of female, and color of legs dark brown to very dark brown, distinctly darker than red background color of metasoma. **Metasoma**: Integumental color pale reddish at base; terga I, II, III each sometimes with indistinct, median transverse darker area subapically; tergum IV varying from being pale reddish to brown; apical terga tending to be very dark brown. Marginal band of plumose setae on tergum IV.

DISTRIBUTION: **California**: *Contra Costa County*: Jersey Island, September 4; Oakley, September 19–26. *Alameda County*: Coyote Creek near Warm Springs, September 20; San Lorenzo, September 4–October 5. *Stanislaus County*: Westley, August 6. *San Joaquin County*: 6 mi west of Tracy, June 1–21, July 27; Stockton, date unknown.

SAMPLE SIZE: Females 28; males 9.

REMARKS: The holotype of *Oreopasites vanduzeei* (Stockton, California) was collected with a "quantity" of *Micronomadopsis hesperia equina* and thereby associated with this host by Cockerell (1925). This host form, then, represents the type population of the species. Larvae were retrieved by the nest of *Mic. h. equina* at San Lorenzo, California. Linsley accorded this form subspecies status distinct from other host forms of *O. vanduzeei.* No specimens of *O. vanduzeei* have been firmly associated with *Mic. h. hesperia* to date.

Host-form "hesperia" is characterized by its small size and by females tending to be much paler than those of other host forms. The range of collection dates indicates that it is multivoltine like its host.

Oreopasites vanduzeei, host-form "edwardsii"

DESCRIPTION: *Female.* Body length 4.7–5.7 mm; length of forewing measured from tip of costal sclerite to apex 3.2–4.1 mm. **Head**: Integumental background color of vertex black; labrum dark reddish brown to almost black, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish, less plumose than those between antennal socket and eye; setae on

antennal scape long, longer ones being somewhat less than one-half length of scape exclusive of basal ball. Approximate ratio of labial palpal segments 1/2/3+4 : 1.3/1.0/0.3–0.4. **Mesosoma**: Mesoscutum black. Recumbent setae on mesoscutum amberish. Forewing with distal end of marginal cell obliquely subtruncate to gradually curving from wing margin. Legs tending to be dark so that hind femora almost always darker than red background color of metasoma. **Metasoma**: Integumental color reddish throughout or with metasomal apex slightly darker than base (in Oregon specimen, apex considerably darker). Dorsal marginal bands of plumose setae inconspicuous because plumose setae sparse and tending to be restricted to sides of terga; band of tergum IV normally broadly interrupted medially.

Male. Body length 4.0–5.6 mm; length of forewing measured from tip of costal sclerite to apex 3.2–4.0 mm. **Head**: Integumental background color of vertex black; labrum very dark brown to black. Setae between lateral ocellus and eye slightly amberish to white, normally less plumose than setae between antennal socket and eye; setae on antennal scape about as long as those of female. **Mesosoma**: As described for female except recumbent setae white to faintly amberish. **Metasoma**: Integumental color reddish at base, becoming somewhat darker toward apex on some specimens; on Oregon specimen, color dark reddish brown at base, becoming even darker apically. On California specimens, marginal band of plumose setae on tergum IV complete or nearly so; on Oregon specimen, band broadly interrupted with setae in middle area nonplumose.

DISTRIBUTION: **California**: *Fresno County*: 11 mi east of Shaver Heights, July 11. *Tuolumne County*: Pinecrest, June 25–27; Strawberry, June 16–July 15. **Oregon**: *Klamath County*: Lake O'Woods, Mt. McLaughlin, June 16.

SAMPLE SIZE: Females 41; males 22.

REMARKS: This host form, associated with *Nomadopsis edwardsii* at a number of localities, appears rather uniform, except a single male and female from Oregon are substantially darker than specimens from California. Larvae of host-form "edwardsii" were found in the nests at two nesting sites of the host bee at Strawberry, California.

Oreopasites vanduzeei,
host-form "zonalis"

DESCRIPTION: *Female*. Body length 3.9–6.0 mm; length of forewing measured from tip of costal sclerite to apex 2.8–4.0 mm. **Head**: Integumental background color of vertex very dark brown to black; labrum medium reddish brown to dark brown, normally darker than background color of metasoma. Setae between lateral ocellus and eye distinctly amberish, much less plumose than those between antennal socket and eye; setae on antennal scape rather short, longer ones being less than one-half length of scape exclusive of basal ball. Approximate ratio of labial palpal segments 1/2/3+4 : 1.5/1.0/0.5. **Mesosoma**: Mesoscutum black or nearly so. Recumbent setae on mesoscutum amberish. Forewing with distal end of marginal cell usually gradually curving from wing margin. Legs tending to be dark so that hind femora usually considerably darker than red background color of metasoma. **Metasoma**: Integumental color reddish, but apical terga on some specimens conspicuously infuscated. Dorsal marginal bands of plumose setae inconspicuous because plumose setae sparse and tending to be restricted to sides of terga; band of tergum IV broadly interrupted medially.

Male. Body length 4.0 mm; length of forewing measured from tip of costal sclerite to apex 2.9–3.0 mm. **Head**: Integumental background color of vertex black; labrum dark reddish brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish, normally less plumose than setae between antennal socket and eye; setae on antennal scape considerably longer than those of female. **Mesosoma**: As described for female. **Metasoma**: Integumental color reddish at base; gradually becoming somewhat darker toward apex, at least in one specimen. Marginal band of plumose setae on tergum IV apparently very broadly interrupted medially.

DISTRIBUTION: **California**: *Mariposa County*: 15 mi east of Mariposa, May 30. *Tuolumne County*: Tuolumne, July 8.

SAMPLE SIZE: Females 13; males 2.

REMARKS: Both samples were found flying over the nests of *Nomadopsis zonalis sierrae*, and immatures were collected at the Tuolumne site.

Specimens have the dark aspect of host-form "edwardsii" and host-form "anthidia" from the same region.

Oreopasites vanduzeei,
host-form "comptula"

DESCRIPTION: *Female*: Body length approximately 5.0 mm; length of forewing measured from tip of costal sclerite to apex 3.6 mm. **Head**: Integumental background color of vertex very dark brown; labrum pale reddish brown, approximately concolorous with background color of metasoma. Setae between lateral ocellus and eye white to distinctly amberish, less plumose than those between antennal socket and eye; setae on antennal scape moderately long, longer ones being somewhat less than one-half length of scape exclusive of basal ball. Mouthparts not measured. **Mesosoma**: Mesoscutum dark to very dark brown. Recumbent setae on mesoscutum amberish. Forewing with distal end of marginal cell gradually curving from wing margin. Legs tending to be pale so that hind femora concolorous with red background color of metasoma. **Metasoma**: Integumental color reddish throughout. Dorsal marginal bands of plumose setae inconspicuous because plumose setae sparse and tending to be restricted to sides of terga; band of tergum IV broadly interrupted medially.

Male. Body length 5.3 mm; length of forewing measured from tip of costal sclerite to apex 3.4 mm. **Head**: Integumental background color of vertex nearly black; labrum dark brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye grayish, scarcely amberish, normally less plumose than setae between antennal socket and eye; setae on antennal scape about same length as those of female. **Mesosoma**: As described for female except integumental color very dark brown and color of legs dark brown, distinctly darker than red background color of metasoma. **Metasoma**: Integumental color pale reddish throughout. Marginal bands of plumose setae on tergum IV apparently complete.

DISTRIBUTION: **California**: *San Bernardino County*: Lake Arrowhead, San Bernardino Mountains, July 9.

SAMPLE SIZE: Female 1; male 1.

REMARKS: Only two specimens of this host form were collected in association with *Nomadopsis comptula*. Because they are in poor condition, they were not dissected for fear of further damage.

Oreopasites vanduzeei,
host-form "puellae"

DESCRIPTION: *Female*: Body length 3.9–6.0 mm; length of forewing measured from tip of costal sclerite to apex 2.7–4.3 mm. **Head**: Integumental background color of vertex almost always black; labrum medium brown to reddish brown, almost always distinctly darker than metasoma. Setae between lateral ocellus and eye nearly white (California specimens) to distinctly amberish (most Arizona specimens); setae on antennal scape long, longer ones being approximately one-half length of scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.6/1.0/0.4. **Mesosoma**: Mesoscutum dark black or nearly so. Recumbent setae on mesoscutum white to amberish. Forewing with distal end of marginal cell gradually curving from wing margin (mostly Arizona specimens) to obliquely subtruncate (California specimens). Legs tending to be pale so that hind femora concolorous with red background color of metasoma. **Metasoma**: Integumental color pale reddish throughout. Dorsal marginal bands of plumose setae rather inconspicuous because plumose setae tending to be restricted to sides of terga; band of tergum IV broadly interrupted medially.

Male. Body length 4.6–5.6 mm; length of forewing measured from tip of costal sclerite to apex 3.3–3.9 mm. **Head**: Integumental background color of vertex black; labrum dark brown to very dark brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye white to amberish; setae on antennal scape about as long as those of female. **Mesosoma**: As described for female except color of legs tending to be darker, so that hind femora usually distinctly darker than red background color of metasoma. **Metasoma**: Integumental color reddish throughout, but apex on some specimens somewhat infuscated. Marginal band of plumose setae on tergum IV complete to interrupted medially.

DISTRIBUTION: **California**: *San Bernardino County*: Palm Wells, April 27–29; Morongo

Valley, April 16–25. **Arizona**: *Cochise County*: 2 mi east of Apache, May 3; Skeleton Canyon, Peloncillo Mountains, April 26–May 4.

SAMPLE SIZE: Females 42; males 6.

REMARKS: Host-form "puellae" has been associated with *Nomadopsis puellae* in the deserts of California and southern Arizona. Immatures have been recovered from host nests at Skeleton Canyon, Arizona, and Palm Wells, California. California adults reveal considerable decumbent white hair on the vertex and mesoscutum, and the marginal cell is obliquely subtruncate on most specimens. In contrast, the Arizona material shows much more amberish hair on the vertex and mesoscutum, and the marginal cell gradually bends from the wing margin.

This host form is similar to host-form "foleyi," the only difference being the generally larger body (of both adults and postdefecating larvae) of host-form "puellae." However, since some individuals are quite small, like those of host-form "foleyi," the two forms may represent the same genetic population; the two sizes suggest differences in food quantity, determined by hosts of different sizes.

Oreopasites vanduzeei, host-form "obscurella"

DESCRIPTION: *Female*. Body length 5.2–7.4 mm; length of forewing measured from tip of costal sclerite to apex 3.4–4.0 mm. **Head**: Integumental background color of vertex black, or nearly so; labrum reddish brown (approximately concolorous with background color of metasoma) to medium brown. Setae between lateral ocellus and eye amberish, less plumose than those between antennal socket and eye; setae on antennal scape moderately short, longer ones being less than one-half length of scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.3/1.0/0.3. **Mesosoma**: Mesoscutum black or nearly so. Recumbent setae on mesoscutum amberish. Forewing with distal end of marginal cell intermediate between gradually curving from wing margin and being obliquely subtruncate. Legs tending to be pale so that hind femora concolorous with red background color of metasoma, or nearly so. **Metasoma**: Integumental color reddish throughout. Dorsal marginal bands of plumose setae inconspicuous because setae tending to be restricted to sides of terga; band of tergum IV broadly interrupted medially.

Male. Body length 5.0–6.1 mm; length of forewing measured from tip of costal sclerite to apex 3.3–4.0 mm. **Head**: Integumental background color of vertex black; labrum dark reddish brown to very dark brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish, normally less plumose than setae between antennal socket and eye; setae on antennal scape somewhat longer than those of female. **Mesosoma**: As described for female except color of legs dark reddish brown to dark brown, distinctly darker than red background color of metasoma. **Metasoma**: Integumental color reddish throughout except on several specimens where apex is slightly darkened. Marginal band of plumose setae on tergum IV nearly complete to interrupted medially.

DISTRIBUTION: **California**: *San Luis Obispo County*: Santa Margarita, May 4.

SAMPLE SIZE: Females 13; males 6.

REMARKS: This is the only sample of *Oreopasites vanduzeei* flying in association with *Nomadopsis obscurella*. Specimens are remarkably similar to host-form "puellae" in size and coloration, although there are no very small specimens, and the recumbent setae on vertex and mesoscutum are distinctly amberish, in contrast to the California specimens of host-form "puellae." Like host-forms "puellae" and "foleyi," the vertex and mesoscutum have a nearly black background color; the legs, especially the hind ones of the females, are concolorous with the metasoma, and the metasoma on both sexes tends to be red throughout.

Oreopasites vanduzeei, host-form "anthidia"

DESCRIPTION: *Female*. Body length 4.3–6.5 mm; length of forewing measured from tip of costal sclerite to apex 3.2–4.3 mm. **Head**: Integumental background color of vertex dark brown to black; labrum medium brown to dark brown, darker than background color of metasoma. Setae between lateral ocellus and

eye amberish, darker and less plumose than setae between antennal socket and eye; setae on antennal scape long, longer ones being somewhat less than length of scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.4/1.0/0.3. **Mesosoma**: Mesoscutum usually black, rarely very dark brown. Recumbent setae on mesoscutum amberish. Forewing with distal end of marginal cell obliquely subtruncate to gradually curving from wing margin. Hind femora varying from being concolorous with red of metasoma to being very dark brown. **Metasoma**: Integumental background color varying from being reddish throughout to having marginal areas distinctly infuscated so that metasomal apex medium brown. Dorsal marginal bands of plumose setae inconspicuous; band of tergum IV broadly interrupted medially.

Male. Body length 4.2–6.6 mm; length of forewing measured from tip of costal sclerite to apex 3.2–4.1 mm. **Head**: Integumental background color of vertex black; labrum very dark brown to nearly black. Setae between lateral ocellus and eye somewhat amberish but often less so than those of female; setae on antennal scape long, longer ones being approximately one-half length of scape exclusive of basal ball. **Mesosoma**: As described for female except color of legs dark brown to very dark brown, distinctly darker than red background color of metasoma in all cases. **Metasoma**: Integumental color varying greatly especially from locality to locality; on some specimens integument reddish throughout, on others dark reddish brown throughout, and still others, grading between these extremes with apex of metasoma tending to be darker than base. Marginal bands of plumose setae on tergum IV in some cases complete, but in other cases median gap obscured by rather dense simple setae.

DISTRIBUTION: **California**: *Madera County*: [no locality] 3000 ft, May 27. *Mariposa County*: Indian Flat, May 23. *Stanislaus County*: Turlock, May 9. *Tuolumne County*: Tuolumne City, May 30–June 14. *Shasta County*: Hat Creek, June 27–July 2. **Utah**: *Cache County*: 6 mi northwest of Logan.

SAMPLE SIZE: Females 23; males 17.

REMARKS: This form has been collected in association with *Macronomadopsis a. anthidia* and *Mac. a. lutea*, very distinctive subspecies. The Hat Creek and Utah material was tied to *Mac. a. lutea* whereas the Tuolumne City and Madera County specimens were linked with *Mac. a. anthidia*. Immatures of *Oreopasites* were retrieved from the nests of *Mac. a. anthidia* at Tuolumne City, California. Torchio (personal commun.) associated this *Oreopasites* with *Mac. a. lutea* from several localities in Utah and recovered immatures from excavated cells.

Linsley (1941) designated two specimens from Indian Flat and six from Madera County as paratypes of *Oreopasites vanduzeei melanantha*.

Samples from the various localities show considerable variation in size and in color pattern, especially of the metasomal area of the males. Turlock and Tuolumne City specimens are large with reddish metasomas. The Madera and Mariposa County specimens tend to be smaller and darker. The sample from Hat Creek seem to be intermediate in size and color. Samples are so few that no significance can be attached to this variation at present.

Oreopasites vanduzeei, host-form "fracta"

DESCRIPTION: *Female*: Body length 3.2–5.2 mm; length of forewing measured from tip of costal sclerite to apex 2.4–3.3 mm. **Head**: Integumental background color of vertex dark brown to black; labrum pale reddish brown, approximately concolorous with background color of metasoma to dark brown, much darker than metasoma. Setae between lateral ocellus and eye usually amberish, less plumose than those between antennal socket and eye; setae on antennal scape moderately long, longer ones being somewhat less than one-half length of scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.4–1.6/1.0/0.5. **Mesosoma**: Mesoscutum dark brown to black. Recumbent setae on mesoscutum normally amberish. Forewing with distal end of marginal cell obliquely subtruncate to gradually curving from wing margin. Leg coloration variable so that hind femora ranging from concolorous with red background color of metasoma to distinctly darker than metasoma. **Metasoma**:

Integumental color reddish throughout, almost never infuscated at metasomal apex. Dorsal marginal bands of plumose setae inconspicuous because plumose setae sparse and tending to be restricted to sides of terga; band of tergum IV normally broadly interrupted medially.

Male. Body length 3.5–5.0 mm; length of forewing measured from tip of costal sclerite to apex 2.4–3.5 mm. **Head**: Integumental background color of vertex very dark brown to black; labrum medium reddish brown to very dark brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish or perhaps in some cases white, normally less plumose than setae between antennal socket and eye; setae on antennal scape about same length as those of female. **Mesosoma**: As described for female except color of legs dark brown to very dark brown, distinctly darker than red background color of metasoma. **Metasoma**: Integumental color varying from reddish throughout, to red at metasomal base grading to dark at apex, to reddish brown at base and darker brown at apex. Marginal band of plumose setae on tergum IV inconspicuous and interrupted medially.

DISTRIBUTION: **California**: *Riverside County*: San Andreas Canyon, Palm Springs, April 7–18; 2 mi east of Valle Vista, April 30; Chino Canyon, near Palm Springs, April 20; (collected with *Micronomadopsis fracta* and *Nomadopsis linsleyi*); Mt. San Jacinto, 4000 feet, June 6. *Monterey County*: Arroyo Seco, May 1–26. *San Benito County*: 6 mi southeast Idria, June 28 (collected with both *Mic. fracta* and *Mic. trifolii*). *Santa Cruz County*: University of California campus, June 11. *Contra Costa County*: Mount Diablo, May 7–June. *Solano County*: Cold Creek near Monticello Dam, April 30. *El Dorado County*: 3 mi south of Camino, June 26. *Tuolumne County*: Tuolumne City, June 5–22; 4 mi east of Sonora, April 22–24. *Mariposa County*: 15 mi east of Mariposa, May 30.

SAMPLE SIZE: Females 114; males 73.

REMARKS: Although host-form "fracta" is associated with *Micronomadopsis fracta* at numerous localities, *Mic. trifolii* and *Nomadopsis linselyi* also occur at some of these places. The latter species forages from the same food plant as *Mic. fracta* (*Eriodictyon*). Because the overall small body size of this host form correlates with the small body size of *Mic. fracta*, the host-form "fracta" is probably not a parasite of the substantially larger *N. linsleyi*.

The series described above includes type material of both *Oreopasites vanduzeei diabloensis* and *O. vanduzeei xerophila*.

Oreopasites vanduzeei, host-form "barbata"

DESCRIPTION: Female. Body length 3.8–5.2 mm; length of forewing measured from tip of costal sclerite to apex 2.6–3.2 mm. **Head**: Integumental background color of vertex very dark brown to black; labrum reddish brown to dark brown; usually darker than background color of metasoma. Setae between lateral ocellus and eye somewhat amberish, much less plumose than those between antennal socket and eye; setae on antennal scape short, longer ones being approximately one-third length of antennal scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.6/1.0/0.4. **Mesosoma**: Mesoscutum very dark brown to black. Recumbent setae of mesoscutum amberish. Forewing with distal end of marginal cell tending to be obliquely subtruncate. Legs tending to be darker than those of host-form "hesperia," so that hind femora medium reddish brown, distinctly darker than background color of metasoma. **Metasoma**: Integumental color reddish throughout. Dorsal marginal hair band inconspicuous, as in host-form "hesperia."

Male. Body length 3.9–4.8 mm; length of forewing measured from tip of costal sclerite to apex 2.8–3.2 mm. **Head**: Integumental background color of vertex very dark brown to black; labrum medium dark reddish brown to very dark brown, darker than background color of metasoma. Setae between lateral ocellus and eye vaguely white, less plumose than those between antennal socket and eye. **Mesosoma**: Hind femora dark brown to very dark brown. **Metasoma**: Integumental color of basal terga reddish, of apical terga dark reddish brown; one specimen having all terga medium brown. Marginal band of plumose setae on tergum IV sparse but apparently complete, at least on some specimens.

DISTRIBUTION: **California**: *Merced County*: 2 mi, 3 mi south of Hilmar, April 29–May 3.

SAMPLE SIZE: Females 16; males 6.

REMARKS: Adults of this form flew over the nesting areas of *Micronomadopsis barbata*, and its larvae were recovered from nests near Hilmar, California. Although quite similar to the host form associated with *Mic. hesperia equina*, it is univoltine so far as known, and its females tend to be darker.

Oreopasites vanduzeei,
host-form "foleyi"

DESCRIPTION: *Female*. Body length 3.4–4.2 mm; length of forewing measured from tip of costal sclerite to apex 2.4–3.05 mm. **Head**: Integumental background color of vertex very dark brown to black, usually black; labrum medium reddish brown to dark brown, darker than background color of metasoma. Setae between lateral ocellus and eye snowy white, plumose, similar to setae between antennal socket and eye; setae on antennal scape rather long, longer ones being approximately one-half length of antennal scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.3/1.0/0.4. **Mesosoma**: Mesoscutum very dark brown to black. Recumbent setae of mesoscutum glistening snowy white; discal setae on mesoscutum of unworn specimens apparently strongly plumose. Forewing with distal end of marginal cell tending to be obliquely subtruncate. Hind femora medium reddish, usually concolorous with background color of metasoma. **Metasoma**: Integumental background color reddish throughout. Dorsal marginal bands of plumose setae tending to be more conspicuous than those of host-forms "hesperia" and "barbata," because setae denser, more extensive, and more plumose; band of tergum IV interrupted medially but not as broadly so as in host-forms "barbata," "hesperia," or "trifolii."

Male. Body length 3.8–4.2 mm; length of forewing measured from tip of costal sclerite to apex 2.4–2.9 mm. **Head**: Integumental background color of vertex black; labrum medium dark reddish brown to very dark brown, darker than background color of metasoma. Setae between lateral ocellus and eye white, probably about as plumose as those between antennal socket and eye. **Mesosoma**: Hind femora medium dark reddish brown, darker than background color of metasoma. **Metasoma**: Integumental background color of basal terga reddish; apical terga usually substantially darker. Marginal band of plumose setae of tergum IV more or less complete.

DISTRIBUTION: **Arizona**: *Yuma County*: North end of Dome Valley near Yuma, April 20. **California**: *Riverside County*: Hopkins Well, April 16.

SAMPLE SIZE: Females 22; males 7.

REMARKS: The Dome Valley sample was collected at the nest area of *Micronomadopsis foleyi*, and the larvae of this host form were recovered from nests. The specimens from Hopkins Well were associated with the same host although *Nomadopsis puellae* was collected simultaneously. Because of the small size of the specimens at Hopkins Well, they were probably not parasites of the larger *N. puellae*. There are no significant differences in the *Oreopasites* from the two localities.

Oreopasites vanduzeei,
host-form "trifolii"

DESCRIPTION: *Female*. Body length 4.3–5.0 mm; length of forewing measured from tip of costal sclerite to apex 3.5–3.8 mm. **Head**: Integumental background color of vertex very dark brown to nearly black; labrum medium brown to medium reddish brown, darker than background color metasoma. Setae between lateral ocellus and eye amberish, darker and less plumose than setae between antennal socket and eye; setae on antennal scape moderately long, longer ones being approximately one-half length of antennal scape exclusive of basal ball. Approximate ratio of labial palpus segments 1/2/3+4 : 1.7/1.0/0.4. **Mesosoma**: Mesoscutum very dark brown to black. Recumbent setae of mesoscutum amberish. Forewing with distal end of marginal cell obliquely subtruncate. Hind femora medium reddish brown, tending to be distinctly darker than background color of metasoma. **Metasoma**: Integumental background color reddish throughout. Dorsal marginal bands of plumose setae inconspicuous; band of tergum IV interrupted medially.

Male. Unknown.

DISTRIBUTION: **California**: *Tuolumne County*: Strawberry, May 27.

SAMPLE SIZE: Females 5.

REMARKS: This form was associated with a nesting area of *Micronomadopsis trifolii* and flew synchronously with other host forms of *Oreopasites vanduzeei* at this locality. Although these five females are rather uniform, there is little else to distinguish them from the others.

Oreopasites vanduzeei,
host-form "scutellaris"

DESCRIPTION: *Female*. Body length 4.1–6.8 mm; length of forewing measured from tip of costal sclerite to apex 3.1–4.6 mm. **Head**: Integumental background color of vertex dark brown to black; labrum reddish brown, approximately concolorous with background color of metasoma to dark brown, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye tending to be whitish on Utah specimens and distinctly amberish on specimens from California, Oregon and Idaho; these setae usually less plumose than those between antennal socket and eye; setae on antennal scape rather long, except shorter on specimens from California. Approximate ratio of labial palpus segments 1/2/3+4 : 1.5–1.7/1.0/0.3–0.4. **Mesosoma**: Mesoscutum dark brown to black. Recumbent setae on mesoscutum normally amberish, except usually white on Utah specimens. Forewing with distal end of marginal cell gradually curving from wing margin, to obliquely subtruncate. Legs tending to be pale so that hind femora often concolorous with red background color of metasoma throughout range of host form, but legs darker on some specimens. **Metasoma**: Integumental color tending to be reddish throughout on specimens from California and Oregon, but on specimens from Idaho and Utah, marginal areas of terga III–IV often more or less infuscated. Dorsal marginal bands of plumose setae varying from being inconspicuous (because plumose setae sparse and tending to be restricted to sides of terga) (mostly California specimens) to being conspicuous (because plumose setae dense and extremely plumose) (Idaho and Utah specimens); band of tergum IV broadly interrupted medially, (mostly California specimens) to being complete (mostly Utah specimens).

Male. Body length 4.7–6.0 mm; length of forewing measured from tip of costal sclerite to apex 3.2–3.7 mm. **Head**: Integumental background color black or nearly so; labrum dark brown to nearly black, distinctly darker than background color of metasoma. Setae between lateral ocellus and eye amberish to nearly white, normally less plumose than setae between antennal socket and eye; setae on antennal scape somewhat longer than those of female. **Mesosoma**: As described for female except color of legs dark brown to very dark brown, distinctly darker than red background color of metasoma. **Metasoma**: Integumental color pale, usually reddish at base, normally becoming darker toward apex. Marginal band of plumose setae on tergum IV varying from being inconspicuous and interrupted medially (many Californian specimens) to conspicuous because of dense, highly plumose setae and uninterrupted medially (most Utah specimens).

DISTRIBUTION OF MATERIAL ASSOCIATED WITH *MICRONOMADOPSIS SCUTELLARIS*: **California**: *Stanislaus County*: Turlock, May 26–June 8. **Oregon**: *Klamath County*: Lower Klamath Lake, August 14, 15. **Utah**: *Cache County*: Logan, June 26; 3 mi north of Logan, August 19; 25 mi north of Logan, June 18; Logan Airport, July 7; Trenton, July 17–28; Newton Dam, July 8; Benson, August 4; 6 mi west of Smithfield, July 24; Smithfield, July 8. **Idaho**: *Franklin County*: 2 mi west of Preston.

DISTRIBUTION OF MATERIAL ASSOCIATED WITH *MICRONOMADOPSIS PERSONATA*: **Washington**: *Benton County*: 7 mi north of Prosser, June 17, 30. **Oregon**: *Umatilla County*: Wallace Ranch, 5 mi southeast of Umapine, collected in January, presumably as larvae.

SAMPLE SIZE: Females 184; males 31.

REMARKS: This wide-ranging host form is associated with *Micronomadopsis scutellaris scutellaris*, which itself is a wide-ranging and variable species. Larvae were collected from the nests of this host at Trenton, Utah.

Eugene Miliczky found a male and female at the nesting site of *Micronomadopsis personata* in Washington. There appear to be no significant differences between these specimens and those associated with *Mic. scutel-*

laris. The Wallace Ranch specimens were identified from several teneral adults in preservative that Philip F. Torchio reared from larvae along with host adults.

Specimens of *Oreopasites vanduzeei* not associated with hosts

Most specimens of *Oreopasites vanduzeei* are not associated with hosts; their distribution is as follows:

California: *San Diego County*: 7 mi southwest Boulevard, June 10; near Buchman Springs, May 7. *Riverside County*: 4 mi west of Blythe, April 9; Riverside, April 12–May 8; 9 mi north Hemet, May 3; Murrieta, April 18; 12 mi south of Corona, June 19; Gavilan, March 19–May 4; Whitewater Canyon, May 14; San Andreas Canyon, Palm Springs, April 10. *Los Angeles County*: Claremont, no date. *San Bernardino County*: Deep Creek, May 8–16; Barton Flats, July 14; Lake Arrowhead, July 9; Crestline, June 18; Morongo Valley, April 16. *Ventura County*: Sespe Canyon, July 10. *San Luis Obispo County*: 5 mi northeast of Santa Margarita, June 12–15. *Monterey County*: Arroyo Seco, April 20–June 27; Hastings Reservation, near Jamesburg, May 7; 7 mi east San Lucas, July 31. *San Benito County*: Idria (gem mine), June 15. *Santa Cruz County*: Felton, Santa Cruz Mountain, May 15–19. *Santa Clara County*: San Antonio, June 3. *Alameda County*: Coyote Creek near Warm Springs, September 17–October 1; Fremont, August 23. *Contra Costa County*: Mitchell Canyon near Clayton; Rock City, Mount Diablo, April 29. *Napa County*: Samuel Springs, May 16–22. *Yolo County*: Rumsey, May 17; Bear Cache Creek Junction, May 17. *Lake County*: Cache Creek, May 17. *Tehama County*: 4 mi north Paynes Creek, May 21. *Shasta County*: Hat Creek, June 25–July 3; Old Station, July 2–3; Cassel, May 25–June 5; 5 mi east of Burney, June 9; Shingletown, May 23; Moose Camp, July 14. *Siskiyou County*: Mount Shasta City, June 26–27; Lower Klamath Lake, August 11. *Butte County*: 13 mi northeast Chico, May 22. *Sierra County*: Independence Lake, July 2–16. *Nevada County*: Sagehen Creek, June 19–July 22. *El Dorado County*: Fred's Place, July 10; 8 mi on Ice House Road, July 5; Pollock Pines, June 16; Kyburz, May 30; Pilot Creek, June 26; Blodjett Forest, 13 mi east Georgetown, July 13; Snowline Camp, June 20; Echo Lake, July 21. *Sacramento County*: Sacramento, May 24, August 3; Folsom, May 19. *Amador County*: Hams Station, June 10. *Alpine County*: Hope Valley, July 18. *Tuolumne County*: Tuolumne City, May 22–June 3; Strawberry, June 18–July 15; 8 mi east-northeast of Sonora, June 28; Long Barn, June 16; 5 mi northwest of Columbia, June 6. *Stanislaus County*: Turlock, April 30–June 21, October 3. *Mariposa County*: El Portal, May 18–23; Yosemite, elevation 3880–4000 ft, June 8. *Madera County*: San Joaquin Experiment Station, April 23–26. *Tulare County*: Lemon Cove, April 14. *Inyo County*: Lone Pine, June 5–July 7; Little Lake, April 11. **Oregon**: *Klamath County*: Klamath Falls, July 9–August 5; Klamath Experiment Station, August 3. *Clackamas County*: Mt. Hood, July. *Malheur County*: ½ mi south Malheur Experiment Station, July 20; Ontario Experiment Station, July 6; Ontario, July 10. **Idaho**: *Owyhee County*: Hot Spring, July 5. *Franklin County*: Preston, June 30; 2 mi west Preston, July. **Utah**: *Cache County*: Senson, June 26; Cornish, July 2–10; 3 mi north of Logan, August 13–17; Logan, July 1; Trenton, July 24–28. **Wyoming**: *Sweetwater County*: 15 mi south of Green River, July 14. **Nevada**: *Eureka County*: Beowawe, July 17. *Washoe County*: Nixon, June 22. **Arizona**: *Santa Cruz County*: Tubac, April 14. *Yuma County*: 11 mi north Quartzsite, March 27.

SAMPLE SIZE: Females 411; males 317.

Oreopasites albinota Linsley

Figure 30

Oreopasites albinota Linsley, 1941: 313 (type, female, collection of California Academy of Sciences).

DIAGNOSIS: This species, known only from the holotype, a female from Yermo, California, agrees in almost all respects with females of *Oreopasites vanduzeei*; except for its larger body size, it is nearly indistinguishable from *O. vanduzeei*, host-form "foleyi." As in host-form "foleyi" the setae on the vertex and the decumbent setae of the mesoscutum are glistening white. *Oreopasites albinota* is being provisionally maintained separately from *O. vanduzeei* because its male is unknown, so

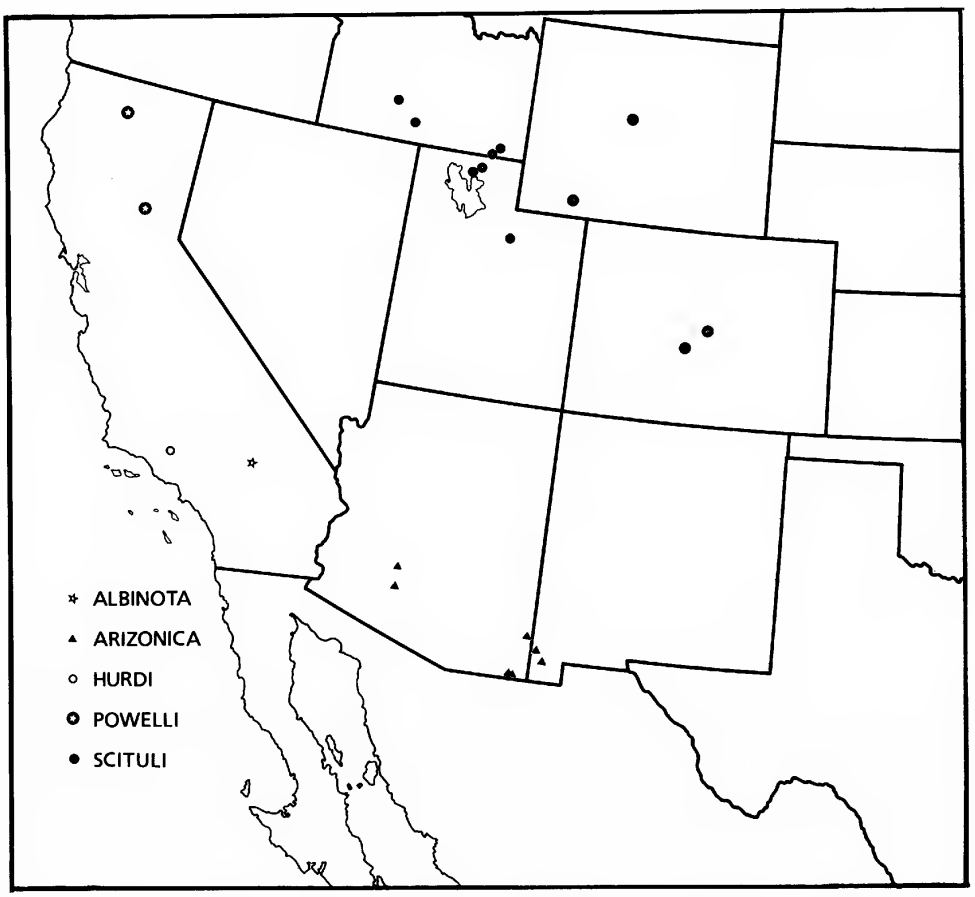


Fig. 30. Distribution of *Oreopasites albinota*, *O. arizonica*, *O. hurdi*, *O. powelli*, and *O. scituli*.

that possible diagnostic features of the male genitalia cannot be studied. This species can be distinguished from *O. vanduzeei* only on the basis of large body size combined with dense white vestiture.

DESCRIPTION: *Female*. Body length 5.5 mm; length of forewing, measured from tip of costal sclerite to apex, 3.8 mm. **Head**: Integumental color of vertex black; labrum mostly obscured by extended mouthparts but medium brown at base. Setae between lateral ocellus and eye white, plumose, essentially the same as setae between antennal socket and eye; setae on antennal scape long, longest ones being approximately half length of scape, exclusive of basal ball. Inner orbits converging below; clypeus long, about as in *Oreopasites vanduzeei*; clypeus moderately protuberant as in *O. vanduzeei*; gena wide; occipital carina distinct only above, fading out part way down gena as seen in lateral view. Scape, exclusive of basal ball, and combined first three flagellomeres subequal in length. Mouthparts long so that in repose galea extending to base of stipites; maxillary palpi obscured by other mouthparts, but basal segments long and therefore each palpus assumed to be six-segmented. Galea, apicad of palpal insertion, longer than maximum eye length in lateral view. Labial palpus four-segmented, with approximate ratio of segments 1/2/3+4 : 1.3/1.0/0.35. **Mesosoma**: Mesoscutum black; mesoscutellum slightly paler; pleural regions black. Recumbent setae on mesoscutum snowy white; discal setae on mesoscutum dense, strongly plumose, and only very faintly amberish; mesoscutal disk shiny between moderately dense punctures that tend to be evenly spaced. Forewing with distal end of marginal cell subtruncate; vein second m-cu joining M basad of junction of second r-m and M; hind wing with vein R_s

approximately twice as long as r-m. Hind femora concolorous with red background color of metasoma; suberect spinelike setae on outer surface of middle and hind tibiae rather long and stout, refracting amber, hence distinct from appressed setae. **Metasoma**: Integumental color reddish throughout. Dorsal marginal bands of plumose setae conspicuous where present, being composed of dense, white plumose setae; marginal band of plumose setae on tergum IV interrupted medially. Tergum VI not dissected but appearing to be evenly curved, as in *O. vanduzeei*; sterna III and IV, each with marginal area glabrous (in contrast to statement in original description); sternum V with subapical hair collar forming rather deep inverted "V"; collar consisting solely of short setae as in *O. vanduzeei*; sternum VI not dissected.

Male. Unknown.

DISTRIBUTION: The type bears the following information: Yermo, April 28 (M. A. Cazier).

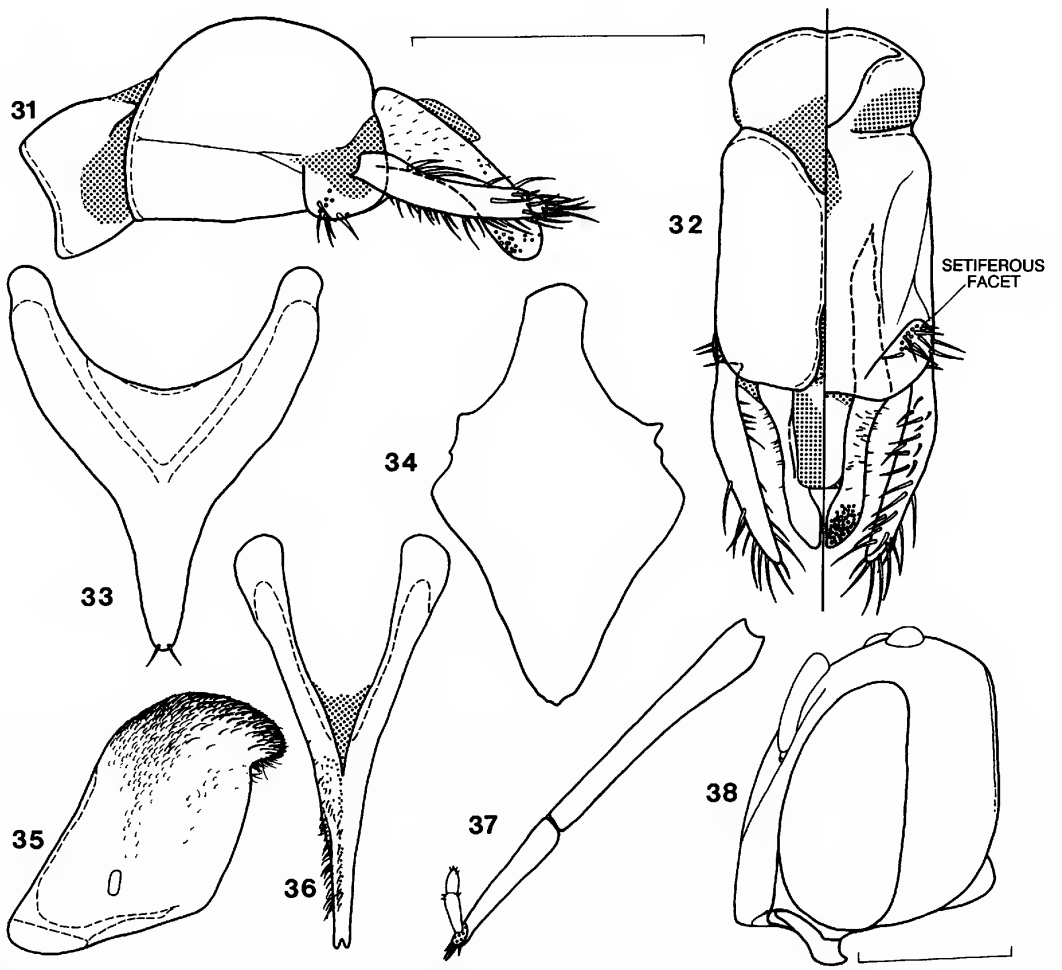
REMARKS: Additional specimens of *Oreopasites*, especially males, from the vicinity of Yermo, California, need to be collected and examined to determine whether *O. albinota* and *O. vanduzeei* are distinct.

Oreopasites scituli Cockerell
Figures 17, 30–38

Oreopasites scituli Cockerell, 1906: 442 (type male, in the collection of P. H. Timberlake, deposited in the California Academy of Sciences).

DIAGNOSIS: *Oreopasites scituli* is a moderate-sized species characterized by having a nearly impunctate, highly polished mesoscutal disk. This shiny disk, six-segmented maxillary palpi, and Utah-Colorado-Wyoming-Idaho distribution permit it to be distinguished from other members of the genus. In addition, the extremely elongate sternum VI (fig. 36) of the female is unique, and the narrow gonobase (fig. 32) resembles only that of *O. arizonica*, which has much shorter gonostyli and penis valves compared with *O. scituli*.

DESCRIPTION: *Female*. Body length 4.3–5.3 mm; length of forewing measured from tip of costal sclerite to apex 3.15–3.9 mm. **Head**: Integumental color of vertex on specimens from Utah black, on specimens from Colorado very dark brown; labrum dark reddish brown, darker than red of metasoma. Setae between lateral ocellus and eye white, moderately plumose, less so than setae between antennal socket and eye; setae on antennal scape longer than one-third length of scape exclusive of basal ball. Inner orbits converging only very slightly below; clypeus (fig. 38) moderately long and protuberant; gena moderately wide; occipital carina distinct only above, fading out halfway down gena as seen in lateral view (fig. 38). Scape, exclusive of basal ball, slightly longer than first three flagellomeres combined. Mouthparts rather long so that in repose galeae extending to base of stipites; maxillary palpus six-segmented; galea apical of insertion of palpus subequal in length to maximum eye length in lateral view; labial palpus (fig. 37) four-segmented, with approximate ratio of segments 1/2/3+4:1.7/1.0/0.4. **Mesosoma**: Mesoscutum and mesoscutellum black except for very dark brown on Colorado specimens; pleural regions black to dark brown. Recumbent setae of mesoscutum white, plumose; discal setae on mesoscutum of unworn specimens very sparse, short, plumose; mesoscutal disk polished between very sparse, irregularly spaced punctures. Forewing with distal end of marginal cell varying from curving from wing margin to being obliquely subtruncate; vein 2nd m-cu joining M somewhat basad of junction of 2nd r-m and M; hind wing with vein R_s about twice as long as r-m. Hind femora normally very dark brown, darker than red coloring of metasoma; on Colorado specimens hind femora brown; suberect spinelike setae on outer surface of middle and hind tibiae long, stout, and many of them refracting amber and hence not concolorous with appressed setae. **Metasoma**: Integumental color dark reddish on terga I and II, usually III and sometimes IV; other terga on Colorado specimens medium reddish brown, on other specimens medium reddish brown to very dark brown. Dorsal marginal hair bands conspicuous where present, on unworn specimens being composed of dense, white, plumose setae. Tergum VI (fig. 35), as seen in lateral view, with dorsal silhouette curving strongly but evenly downward, similar in shape to that of *O. arizonica* but apical hairs very short. Sterna III, IV (figs. 17) with marginal areas polished and with,



Figs. 31–38. *Oreopasites scituli*. **31**, **32**. Male genitalia, lateral, dorsal, and ventral views. **33**. Male metasomal sternum VII, ventral view. **34**. Male metasomal sternum VIII, ventral view. **35**. Female metasomal tergum VI, lateral view. **36**. Female metasomal sternum VI, ventral view. **37**. Labial palpus. **38**. Female head, lateral view. Scale lines (= 0.5 mm) refer to figures 31 and 32, and 38 respectively.

at most, a few widely scattered setae; sternum V (fig. 17) with subapical hair collar inconspicuous because setae both laterally and in middle elongate and essentially identical to other postgradular setae; this sternum with longitudinal median, glabrous, somewhat produced ridge, similar to, but more conspicuous than, that found in *O. favreauae, O. barbarae*, and others; sternum VI (fig. 36) slender apically, and extremely elongate and consequently tending to project in situ considerably beyond apex of metasoma (fig. 17).

Male. Body length 4.95–5.5 mm; length of forewing measured from tip of costal sclerite to apex 3.5–3.9 mm. **Head**: Integumental color of vertex on Colorado specimen (holotype) very dark brown, on other specimens black; labrum medium brown on holotype, black on other specimens. Other features of head as described for female. **Mesosoma**: As described for female. **Metasoma**: Integumental color varying from brown (except for distinct transverse reddish marginal area of tergum I and vague transverse paler areas on margins of other terga) to having terga I–III reddish and terminal terga brown to very dark brown. Sternum IV with marginal area glabrous except sometimes at extreme base; sterna VII and VIII (figs. 33, 34) as illustrated; gonocoxites (fig. 32) very elongate, slender, similar to those of *Oreopasites arizonica*, and also similar to those of *O. favreauae* and *O. eu-*

phorbiae but even more elongate; penis valves and gonostyli of normal length, not short as in *O. arizonica*.

DISTRIBUTION: Total specimens examined: 70. **Colorado**: *Park County*: Lake George, July 5 (holotype). *Chaffee County*: Salada, June 20. **Idaho**: *Franklin County*: Preston, June 30, July 10; 3 mi north of Preston, September. *Twin Falls County*: Murtaugh, July 13. *Gooding County*: Hagerman, July 13. **Utah**: *Box Elder County*: Tremonton, July 27; 10 mi southwest of Tremonton, July 24, 26. *Wasatch County*: Ironton, July 11. **Wyoming**: *Fremont County*: Shoshoni, July 21. *Sweetwater County*: 15 mi south of Green River, July 14.

REMARKS: This uncommonly encountered species, the type of the genus, is known from but a few localities in the northern Rocky Mountain states. The right antenna of the type from Lake George, Colorado is malformed.

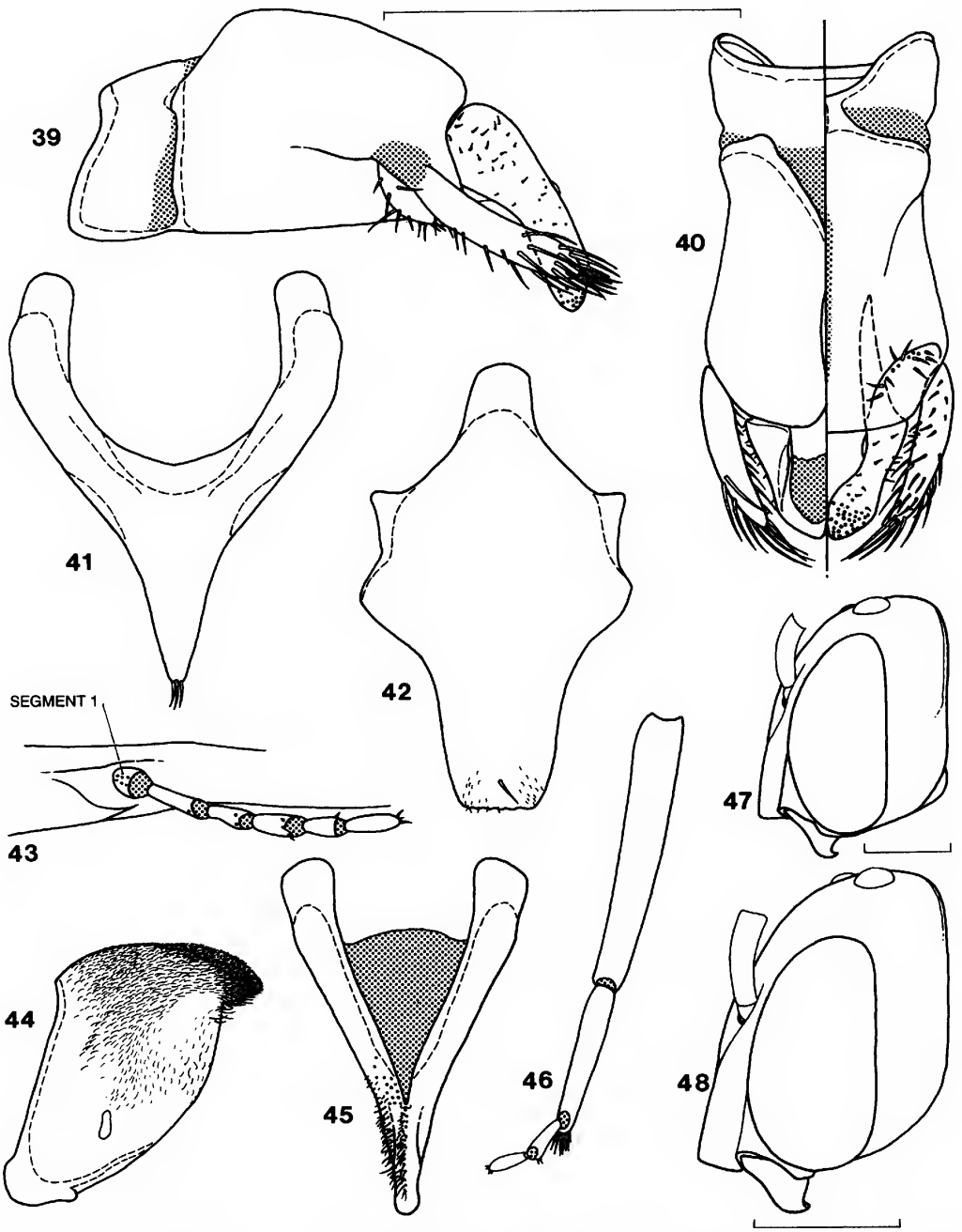
The holotype, allotype, and two pupae were reared from the nests of *Micronomadopsis scitula* by Cockerell (1925). In July 1961 I observed adult females flying around the nesting site of *Mic. scutellaris* near Tremonton, Utah, and recovered several first instars from the cells of this host. Consequently, *Oreopasites scituli* has at least two *Micronomadopsis* hosts, both belonging to the *Scutellaris* group.

Oreopasites arizonica Linsley
Figures 18, 30, 39–47

Oreopasites arizonica Linsley, 1941: 310 (type female, in collection of P. H. Timberlake, deposited in the California Academy of Sciences).

DIAGNOSIS: A large, robust, coarsely punctate species, *Oreopasites arizonica* is not likely to be confused with most species found in Arizona. Females can be separated from all others on the basis of the characteristic hair collar of sternum V (fig. 18). The coarsely, but sparsely, punctate mesoscutal disk is distinct from the finely, but densely, punctate disk of large members of the *O. vanduzeei* host forms. The moderate length of sternum VI (fig. 45) contrasts sharply with that of the female of *O. scituli*, which it closely resembles in many other respects. The male genitalia (fig. 40) are elongate and slender like those of *O. scituli*, but the shortened penis valves and gonostyli are unique for the genus.

DESCRIPTION: *Female*. Body length 5.25–6.75 mm; length of forewing measured from tip of costal sclerite to apex 4.0–4.9 mm. **Head**: Integumental color of vertex black; labrum very dark brownish red when extended, dark reddish brown when folded. Setae between lateral ocellus and eye usually grayish, moderately plumose, usually distinctly darker than white, strongly plumose setae between antennal socket and eye; setae on antennal scape somewhat longer than one-third length of scape exclusive of basal ball. Inner orbits converging slightly below; clypeus rather protuberant; gena moderately wide, occipital carina distinct only above, fading out halfway down gena as seen in lateral view (fig. 47). Scape, exclusive of basal ball, shorter than first three flagellomeres combined. Mouthparts sufficiently long so that in repose galeae extending to base of stipites; maxillary palpus six-segmented; galea apicad of insertion of palpus subequal in length to maximum eye length in lateral view; unlike that of any other *Oreopasites*, flabellum very large, distinctly longer than labial palpal segments 3 and 4 combined; labial palpus (fig. 46) four-segmented, with approximate ratio of segments 1/2/3+4 : 1.8/1.0/0.6. **Mesosoma**: Mesoscutum and mesoscutellum black; pleural regions black except on holotype where they are partly very dark brown. Recumbent setae of mesoscutum white, plumose around margins; recumbent setae on disk, when not worn, tending to be gray or amberish; discal setae very sparse, short; mesoscutal disk polished between moderately sparse but very coarse, irregularly spaced punctures. Forewing with distal end of marginal cell curving from wing margin; vein 2nd m-cu normally joining M somewhat basad of junction of 2nd r-m and M; hind wing with R_s nearly twice as long as r-m. Hind femora dark red, essentially concolorous with red on metasoma; suberect spinelike setae on outer surface of middle and hind tibiae moderate in length, stout, and many of them refracting amber on most specimens, therefore not concolorous with appressed setae. **Metasoma**: Integumental color dark reddish except that very apex of metasoma which is occasionally slightly darker. Dorsal marginal hair bands conspicuous



Figs. 39–47. *Oreopasites arizonica*. **39, 40**. Male genitalia, lateral, dorsal, and ventral views. **41**. Male metasomal sternum VII, ventral view. **42**. Male metasomal sternum VIII, ventral view. **43**. Maxillary palpus, showing short first segment. **44**. Female metasomal tergum VI, lateral view. **45**. Female metasomal sternum VI, ventral view. **46**. Labial palpus. **47**. Female head, lateral view. Scale lines (= 0.5 mm) refer to figures 39 and 40, and 47 respectively.

Fig. 48. *Oreopasites hurdi*, female head, lateral view. Scale line (= 0.5 mm) as indicated.

where present, on unworn specimens being composed of moderately dense, white, plumose setae. Tergum VI (fig. 44) as seen in lateral view, with dorsal silhouette curving strongly but evenly downward, much as in *O. scituli* except apical hairs conspicuously

denser, longer. Sternum III (fig. 18) with marginal area variably pubescent, on some specimens entire marginal area pubescent, on others posterior part of marginal area glabrous; on a few specimens almost all of marginal area glabrous; sternum IV with marginal area glabrous except on a few specimens (fig. 18) (including holotype) in which there are numerous setae on anterior part of area; sternum V (fig. 18) with subapical hair collar laterally consisting of rather long appressed setae which reach or nearly reach posterior edge of sclerite; collar not expressed mesially; sternum VI (fig. 45) rather slender apically and elongate though conspicuously shorter than that of *O. scituli*.

Male. Body length 5.9–6.25 mm; length of forewing measured from tip of costal sclerite to apex 4.25–4.5 mm. **Head**: As described for female except labrum black to very dark brown. **Mesosoma**: As described for female except pleural areas black and hind femora dark reddish brown to very dark reddish brown, distinctly darker than red of metasoma. **Metasoma**: Integumental color as described for female except terga V, VI, and VII tending to be very dark reddish brown. Sternum IV with marginal area glabrous on some specimens and partly or almost completely pubescent on other specimens; sterna VII and VIII (figs. 41, 42) as illustrated; gonocoxites (fig. 40) elongate, slender, similar to those of *O. scituli*; penis valves and gonostyli abnormally short, unlike those of any other known *Oreopasites*.

DISTRIBUTION: Total specimens examined: 24. **Arizona**: *Maricopa County*: Near Buckeye, March 29 (holotype); Gila Bend, April 11. *Cochise County*: Douglas, August 22–September 1; 1 mi east of Douglas, August 19; 2–6 mi south of San Simon, September 3. **New Mexico**: *Hidalgo County*: Cienega, 13 mi north of Rodeo, August 19; 20–23 mi south of Animas, August 28, September 8.

REMARKS: This uncommonly collected species is restricted to Arizona and New Mexico. It is a parasite of *Hypomacrotera subalpina* (Cockerell) (Rozen, 1970), larvae having been recovered from the cells of the host in Douglas, Arizona. As the host ranges over southern California, Arizona, New Mexico, and into Texas, *O. arizonica* may be more widely distributed than is now indicated. This species has been collected as early as May 11 and as late as September 8, a range suggesting more than one generation a year.

Although *Oreopasites arizonica* and *O. scituli* are quite distinct, they bear many features in common. In addition to the strong red color of the metasoma, they share a weakly punctate mesoscutal disk, a similar shape to tergum VI of the female, and elongate gonocoxites in the males.

Oreopasites hurdi, new species

Figures 30, 48

DIAGNOSIS: This is a medium-sized, robust species characterized by very short setae and dense punctation. It can be distinguished from *Oreopasites favreauae, O. linsleyi*, and *O. euphorbiae*, all of which also have five-segmented maxillary palpi, because of its larger size, lack of metasomal hair bands, and dense punctation.

DESCRIPTION: *Female*. Body length of holotype 4.9 mm; length of forewing measured from tip of costal sclerite to apex 3.5 mm. **Head**: Integumental color of vertex black; labrum very dark reddish brown. Setae between lateral ocellus and eye grayish, distinctly less plumose and darker than setae between antennal socket and eye; setae on antennal scape very short, about one-eighth length of scape exclusive of basal ball. Inner orbits converging slightly below; clypeus (fig. 48) somewhat protuberant; gena (fig. 48) moderately wide; occipital carina (fig. 48) weak, expressed only above, fading out near upper level of eye margin as seen in lateral view. Scape, exclusive of basal ball, and combined first three flagellomeres subequal in length. Mouthparts sufficiently long so that in repose galeae extending to base of stipites; maxillary palpus five-segmented (first segment minute); galea apicad of insertion of palpus subequal in length to maximum eye length in lateral view; labial palpus four-segmented, with approximate ratio of segments 1/2/3+4 : 1.6/1.0/0.5. **Mesosoma**: Mesoscutum and mesoscutellum very black; pleural regions very dark brown to almost black. Recumbent setae of mesoscutum white and plumose along margins; discal setae abundant, gray, and much less plumose than marginal setae, very short; punctures of disk so dense

as to be nearly contiguous, regularly spaced. Forewing with distal end of marginal cell gradually curving from wing margin; vein 2nd m-cu joining M basad of junction of 2nd r-m and M; hind wing with vein R_s about 1.5 times length of r-m. Hind femora medium reddish brown, somewhat darker than red of metasoma; suberect spinelike setae on outer surface of middle and hind tibiae moderately short and stout, refracting amber, consequently distinct from appressed setae. **Metasoma**: Integumental color red except for marginal area of tergum V and for tergum VI, which are very dark red-brown. Dorsal marginal hair bands virtually absent. Tergum VI not dissected, hence shape of silhouette unknown. Sterna III and IV with marginal areas densely setose; sternum V with subapical hair collar laterally consisting of very short, rather dense setae which become sparser toward median line, brush not expressed mesially; sternum VI not dissected but apparently not greatly elongate as apex projecting only slightly from tip of metasoma.

Male. Unknown.

HOLOTYPE: Female, Hungry Valley, 5 mi south of Gorman, Ventura County, California, May 6, 1959, on *Haplopappus cooperi* (P. D. Hurd). The type is on long-term loan from the Essig Museum of Entomology, University of California, Berkeley, to the California Academy of Sciences.

ETYMOLOGY: This species is named for the late Dr. Paul D. Hurd, Jr., who collected the holotype and who made an extensive effort to provide me with specimens for the study of this genus.

REMARKS: This distinctive species is known only from the holotype. *Micronomadopsis fracta* Rozen (det. J. G. Rozen), *Perdita interrupta interrupta* Cresson, and *P. macrostoma* Cockerell (both det. P. H. Timberlake) were collected at the same locality on the same day and therefore might be hosts.

Oreopasites euphorbiae Cockerell
Figures 49–58

Oreopasites euphorbiae Cockerell, 1929: 105 (type male, in the collection of the American Museum of Natural History).

DIAGNOSIS: *Oreopasites euphorbiae*, known only from southern California, is a small, robust, flat-faced, pale-colored species with white, densely plumose setae, and a shiny, weakly punctate mesoscutal disk. Males and females can be distinguished from all others in the genus except *O. collegarum* because of their mouthparts that are so short that the tips of the galeae in repose do not reach the base of the stipites (fig. 55). *Oreopasites euphorbiae* and *O. collegarum* can be separated by the characters given in the key, as well as by disjunct distributions (fig. 49). *Oreopasites euphorbiae* is also similar to *O. favreauae*, but the differences in length of mouthparts and allopatric distribution are diagnostic.

DESCRIPTION: *Female.* Body length 3.4–4.25 mm; length of forewing measured from tip of costal sclerite to apex 2.25– 2.6 mm. **Head**: Integumental color of vertex on most specimens medium red-brown, paler than in most other species; on a few specimens color dark brown; labrum reddish, concolorous with metasomal sterna. Setae between lateral ocellus and eye white, strongly plumose, approximately same as those between antennal socket and eye; setae on antennal scape somewhat less than half length of scape exclusive of basal ball. Inner orbits converging strongly below; clypeus (fig. 58) short, scarcely protuberant; gena (fig. 58) narrow; occipital carina distinct only above, fading out about level of upper margin of eye as seen in lateral view (fig. 58). Scape, exclusive of basal ball, distinctly longer than first three flagellomeres. Mouthparts shorter than those of other species except for *O. collegarum*, so that in repose galeae extending at most halfway between labral apex and base of stipites; maxillary palpus five-segmented; galea (fig. 58) apicad of insertion of palpus about two-thirds maximum eye length in lateral view; labial palpus (fig. 54) four-segmented with approximate ratio of segments 1/2/3+4 : 2.0/1.0/1.0. **Mesosoma**: Mesoscutum and mesoscutellum medium to dark reddish brown, rarely almost black; pleural region somewhat paler than mesoscutum and on many specimens nearly concolorous with metasoma. Recumbent setae of mesoscutum white, plumose (i.e., similar to those of mesepisternum); discal setae on mesoscutum of unworn specimens sparse; mesoscutal disk shiny between sparse irregularly spaced punctures. Forewing with distal end of marginal cell curving from wing mar-

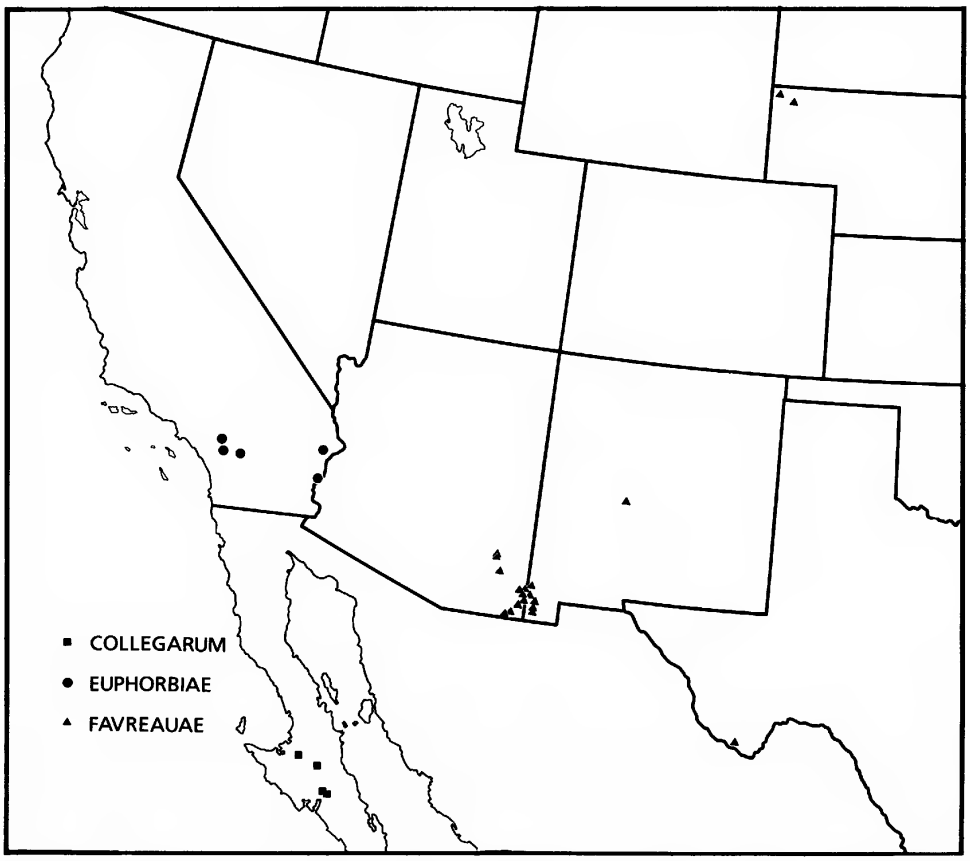
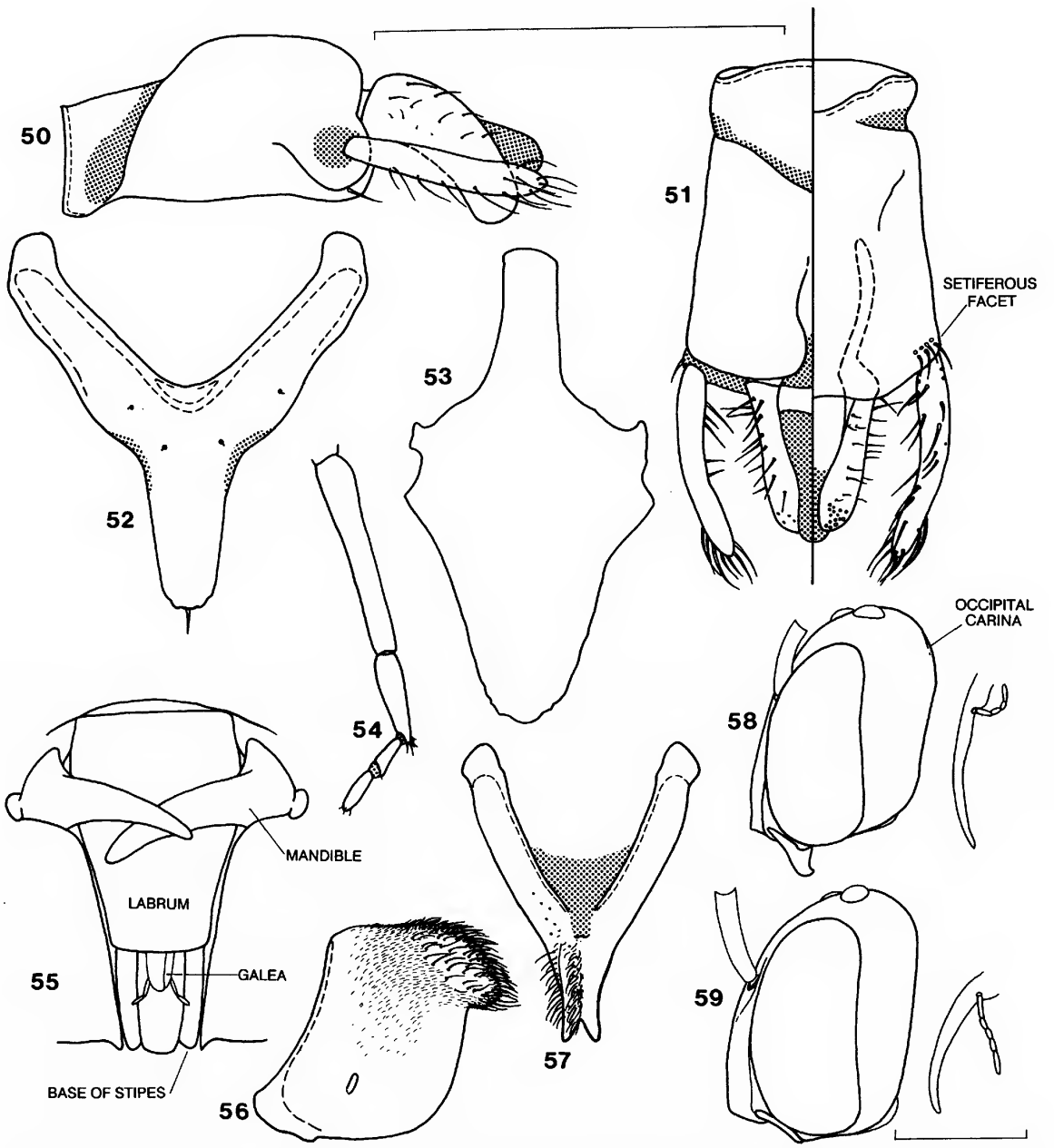


Fig. 49. Distribution of *Oreopasites collegarum*, *O. euphorbiae*, and *O. favreauae*.

gin; vein 2nd m-cu tending to join M somewhat basad of junction of 2nd r-m and M; hind wing with vein R_s almost twice as long as r-m. Legs tending to be pale so that hind femora concolorous with metasoma; suberect spinelike setae on middle and hind tibiae long, stout, refracting white and hence concolorous with appressed setae. **Metasoma**: Integumental color pale reddish throughout. Dorsal marginal hair bands conspicuous where present, composed of dense, white, plumose setae. Tergum VI (fig. 56), as seen in lateral view, with dorsal edge bent abruptly downward at beginning of pygidial area. Sternum III as in *O. favreauae*, with marginal area glabrous except for scattered setae mesially on some specimens; sternum IV as in *O. vanduzeei*, with marginal area glabrous; sternum V as in *O. linsleyi* (fig. 19), with subapical hair collar inconspicuous; at extreme lateral margins of sternum collar composed of short setae (in addition to some long setae) that do not reach posterior margin of sternum; mesially collar consisting of long setae that reach or nearly reach posterior margin and that are essentially identical to other postgradular setae; sternum VI short (fig. 57).

Male. Body length 3.0–4.0 mm; length of forewing measured from tip of costal sclerite to apex 2.2–2.6 mm. **Head**: As described for female except as follows: Integumental color of vertex dark brown to very dark brown, therefore tending to be darker than that of female; labrum red-brown, usually paler than color of face but darker than color of metasomal sterna. Scape subequal to length of first three flagellomeres. **Mesosoma**: As described for female except as follows: Mesoscutum and mesoscutellum dark reddish brown to nearly black; pleural region slightly paler than, to concolorous with, mesoscutum. Legs darker than those of female so that hind femora usually darker than red areas on metasoma. **Metasoma**: On most specimens integumental



Figs. 50–58. *Oreopasites euphorbiae*. **50, 51**. Male genitalia, lateral, dorsal, and ventral views. **52**. Metasomal sternum VIII, ventral view. **54**. Labial palpus. **55**. Proboscidial fossa, ventral view, showing mouthparts in repose, ventral view. **56**. Female metasomal tergum VI, lateral view. **57**. Female metasomal sternum VI, ventral view. **58**. Female head and maxilla, lateral view.

Fig. 59. *Oreopasites collegarum*, female head and maxilla, lateral view.

Scale lines (= 0.5 mm) refer to 50 and 51, and 58 and 59, respectively.

color pale reddish throughout, but on a few specimens tip of metasoma darker than basal segments. Sternum IV with marginal area setose; sterna VII and VIII (figs. 52, 53) as illustrated, somewhat variable in shape; genitalia (fig. 51) like those of *O. favreauae* except gonocoxites slightly more elongate.

DISTRIBUTION: Total specimens examined: 56. **California**: *Riverside County*: Riverside, June 28–September 15; Winchester, July 25;

Palm Springs, October 9; Blythe, June 24. *San Bernardino County*: Vidal, July 6.

REMARKS: There is no question but that *Oreopasites euphorbiae* is a parasite of *Micronomadopsis helianthi*, but its hosts may also include other species as well. Linsley (1941) recorded this species as a parasite of *Mic. helianthi* (as *euphorbiae*) and it has been collected with specimens of this host at Riverside and at Blythe. However, it was taken with *Mic. h. hesperia* and *Mic. helianthi* at Winchester and a single specimen from Palm Springs was collected with *Mic. nigromaculata*, a close relative of *Mic. helianthi*.

The distribution of *Oreopasites euphorbiae* (fig. 49) is considerably more restricted than that of *Micronomadopsis helianthi*. Whereas the parasite is known only from the area around Riverside, California, and the low desert regions of southern California, the host ranges widely from the San Joaquin and Sacramento valleys of California through the Mojave and Colorado Deserts of southern California, through southern Arizona, New Mexico, and as far north as northwestern Nebraska. The host has also been collected almost to the tip of Baja California. *Oreopasites euphorbiae* was not parasitizing the nesting site of *Mic. helianthi* at Artois, Glenn County, California (Rozen, 1958). Nesting sites of *Mic. helianthi* in the vicinity of the Chiricahua Mountains in southeastern Arizona were parasitized by *O. favreauae*, a species which seems to have a completely allopatric distribution with *O. euphorbiae*.

The dates recorded above indicate that *Oreopasites euphorbiae* is bivoltine or multivoltine, as is the case with its host, *Micronomadopsis helianthi*. *Micronomadopsis h. hesperia* and *Mic. nigromaculata* are also multivoltine.

Oreopasites collegarum, new species
Figures 49, 59

DIAGNOSIS: This species is similar to both *Oreopasites euphorbiae* and *O. favreauae*, but males and females can be distinguished from those of all other *Oreopasites* by their very short mouthparts (fig. 59) (the galea is even shorter than that of *O. euphorbiae*, fig. 58) and the six-segmented maxillary palpus. The small body size and a distribution (fig. 49) restricted to Baja California should also help to identify *O. collegarum*.

DESCRIPTION: *Female*. Body length 2.9–4.2 mm; that of holotype 4.2 mm; length of forewing measured from tip of costal sclerite to apex 2.1–2.6 mm. **Head**: Integumental color of vertex very dark brown to black; labrum dark reddish brown, usually somewhat darker than metasomal sterna. Setae between lateral ocellus and eye white, strongly plumose, approximately same as those between antennal socket and eye; setae on antennal scape about one-third length of scape exclusive of basal ball. Inner orbits converging strongly below, about as in *Oreopasites euphorbiae* and *O. favreauae*; clypeus (fig. 59) short, scarcely protuberant, slightly more so than in *O. euphorbiae* but slightly less than in *O. favreauae*; gena (fig. 59) narrow; occipital carina scarcely evident even above, not expressed along posterior margin of gena in lateral view (fig. 59). Scape, exclusive of basal ball, distinctly longer than first three flagellomeres. Mouthparts shorter than those of other species except *O. euphorbiae*, so that in repose galeae extending at most halfway between labral apex and base of stipites; maxillary palpus six-segmented; galea (fig. 59) apicad of insertion of palpus about one-half maximum eye length in lateral view, even shorter than in *O. euphorbiae*; labial palpus four-segmented with approximate ratio of segments 1/2/3+4 : 1.7/1.0/1.0. **Mesosoma**: Mesoscutum and mesoscutellum very dark brown to almost black; pleural region somewhat paler than mesoscutum but always darker than metasoma. Recumbent setae of mesoscutum white, plumose (i.e., similar to those of mesepisternum); discal setae on mesoscutum of unworn specimens rather sparse; mesoscutal disk shiny between sparse, irregularly spaced punctures. Forewing with distal end of marginal cell obliquely subtruncate and not curving from wing margin; vein 2nd m-cu tending to join M well basad of junction of 2nd r-m and M; hind wing with vein R_s almost twice as long as r-m. Hind femur either concolorous with or somewhat darker than metasoma (holotype); suberect spinelike setae on middle and hind tibiae long, stout, refracting white and hence concolorous with appressed setae. **Metasoma**: Integumental color reddish throughout. Dorsal marginal

hair bands conspicuous where present, being composed of dense, white, plumose setae. Tergum VI, as seen in lateral view, with dorsal edge bent abruptly downward at beginning of pygidial area as in *O. euphorbiae* and *O. favreauae*. Sterna III and IV with marginal areas glabrous; sternum V with subapical hair collar inconspicuous; at extreme lateral margins of sternum, collar composed of short setae (in addition to some long setae) that do not reach posterior margin of sternum; mesially collar consisting of long setae that reach or nearly reach posterior margin and that are essentially identical to other postgradular setae; length of sternum VI unknown but probably short as in *O. euphorbiae*.

Male. Body length 3.1–4.2 mm; that of allotype 4.2 mm; length of forewing measured from tip of costal sclerite to apex 2.3–2.9 mm. **Head**: As described for female except as follows: Integumental color of vertex black or nearly so; labrum very dark brown to nearly black. Setae on antennal scape at most one-half as long as scape exclusive of basal ball. Scape subequal to length of first three flagellomeres. **Mesosoma**: As described for female except as follows: Mesoscutum, mesoscutellum, and pleural region black or nearly so. Hind femur dark to very dark brown, darker than red areas on metasoma. **Metasoma**: Integumental color pale reddish at base, becoming darker toward apex so that last three metasomal terga dark brown to black. Sternum IV with marginal area glabrous; sterna VII, VIII, and genitalia like those of *O. favreauae*.

HOLOTYPE: Female, male allotype, 57 km southeast Guerrero Negro, Baja California Sur, Mexico, September 8, 1977 (Roy R. Snelling), elevation 135 m. The holotype and allotype are deposited in the American Museum of Natural History through the courtesy of Roy R. Snelling.

PARATYPES: **Mexico**: *Baja California Sur*: same data as holotype, 11 males, 5 females; Rancho Guadalupe, 24 mi northwest San Ignacio, September 13 (R. R. Snelling), on prostrate *Euphorbia*, 1 female; Punta Abreojos Road, 24 km west San Ignacio, April 19 (C. and E. Slansky, M. Wasbauer), 2 males, 2 females; Rancho Tablon, 13 km south Guillermo Prieto, April 16–18 (J. Slansky, M. Wasbauer), some on *Euphorbia* mats, 8 males.

ETYMOLOGY: The name is derived from the Latin masculine noun *collega* and recognizes my two colleagues, Roy R. Snelling of the Los Angeles County Museum, and Marius S. Wasbauer of the California Department of Food and Agriculture, Sacramento, who collected the type series.

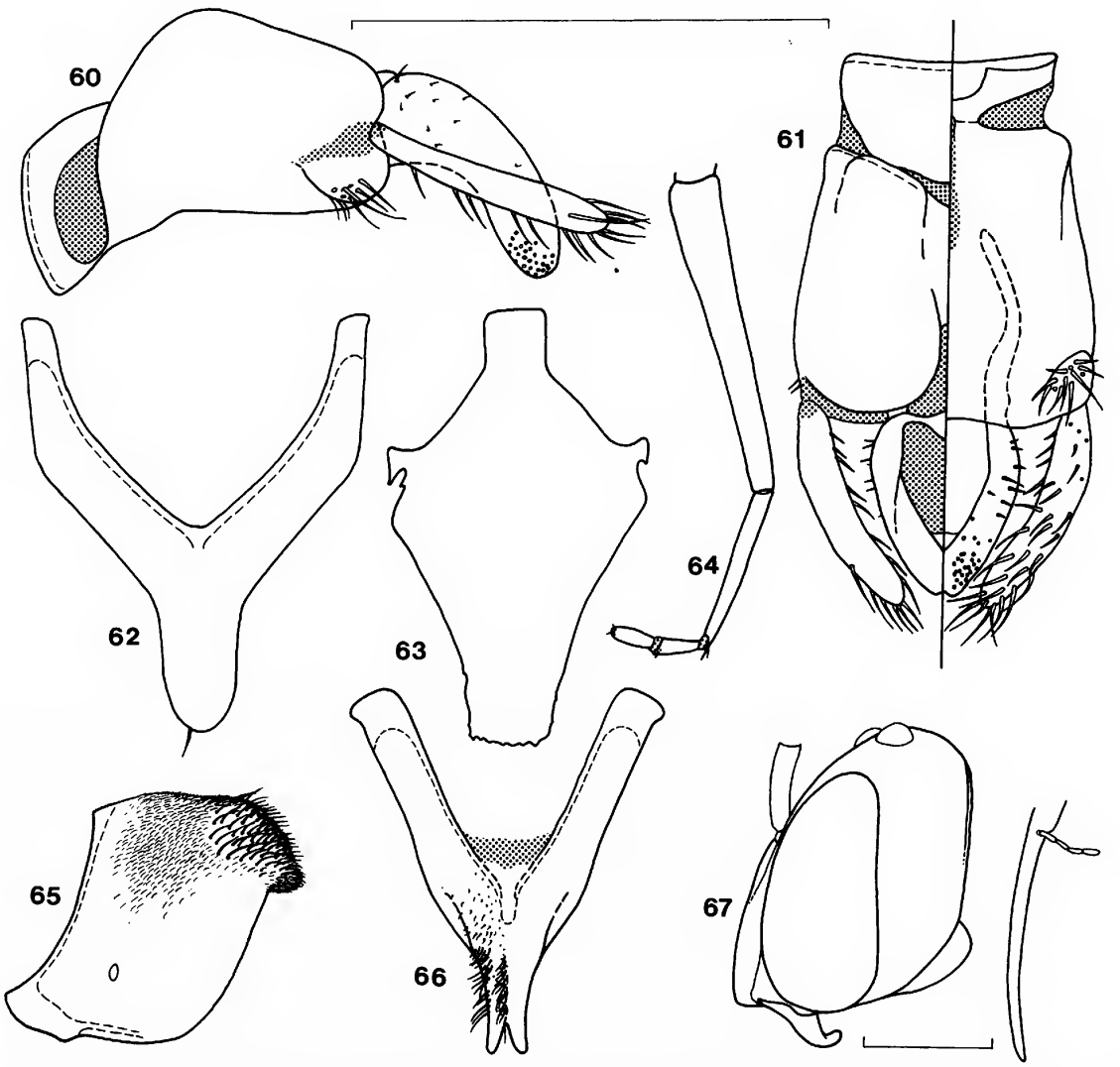
REMARKS: Specimens were collected from a prostrate *Euphorbia* in conjunction with *Micronomadopsis nigromaculata* and a single specimen of *Mic. helianthi*, suggesting that this may be a parasite of *Mic. nigromaculata* and perhaps *Mic. helianthi*.

Oreopasites favreauae, new species

Figures 49, 60–67

DIAGNOSIS: Although its head and metasoma are usually darker, this small, robust species closely resembles *Oreopasites euphorbiae*. Its distribution (fig. 49), allopatric with that of *O. euphorbiae* from southern California, ranges from southern Arizona, southern New Mexico, and western Texas northward to Sioux County and Dawes County, Nebraska. The longer mouthparts (fig. 67), the shorter two terminal segments of the labial palpi (fig. 64) compared with the second segment, and the more robust male genitalia (fig. 61) distinguish *O. favreauae* from *O. euphorbiae*.

DESCRIPTION: *Female*. Body length 3.0–4.75 mm; that of holotype 4.25 mm; length of forewing, measured from tip of costal sclerite to apex 2.2–2.8 mm; that of holotype 2.7 mm. **Head**: Integumental background color of vertex black on most specimens, including holotype, but color dark red brown on some specimens, particularly those from Santa Elena Canyon, Texas; labrum of most specimens reddish, about as pale as, to somewhat paler than, background color of metasoma; on most specimens from Nebraska, labrum dark brown. Setae between lateral ocellus and eye white, strongly plumose, approximately same as those between antennal socket and eye; setae on antennal scape somewhat less than half length of scape exclusive of basal ball. Inner orbits converging moderately below, about as in *O. euphorbiae*; clypeus (fig. 67) short, scarcely protuberant but slightly more protuberant than in *O. euphorbiae*; gena (fig. 67) narrow but slightly



Figs. 60–67. *Oreopasites favreauae*. **60**, **61**. Male genitalia, lateral, dorsal, and ventral views. **62**. Male metasomal sternum VII, ventral view. **63**. Male metasomal sternum VIII, ventral view. **64**. Labial palpus. **65**. Female metasomal tergum VI, lateral view. **66**. Female metasomal sternum VI, ventral view. **67**. Female head and maxilla, lateral view. Scale lines (= 0.5 mm) refer to figures 60 and 61, and 67, respectively.

wider than that of *O. euphorbiae*; occipital carina distinct only above, fading out part way down posterior margin of gena as seen in lateral view (fig. 67). Scape, exclusive of basal ball, subequal to, or longer than, first three flagellomeres. Mouthparts (fig. 67) of moderate length, longer than those of *O. euphorbiae* so that in repose galeae extending to base of stipites; maxillary palpus five-segmented; galea (fig. 67) apicad of insertion of palpus subequal in length to maximum eye length in lateral view; labial palpus four-segmented, with approximate ratio of segments 1/2/3+4 : 2.0/1.0/0.6. **Mesosoma**: Mesoscutum and mesoscutellum usually very dark brown to black; on some specimens from Santa Elena Canyon these areas medium dark reddish brown; pleural regions medium dark reddish brown to black. Recumbent setae on mesoscutum white, strongly plumose; discal setae on mesoscutum of unworn specimens very sparse; mesoscutal disk shiny between

sparse, irregularly spaced punctures. Forewing with distal end of marginal cell bending away from costal margin more gradually than in *O. linsleyi* and *O. barbarae* so that end scarcely seems truncate, similar to *O. euphorbiae*; vein 2nd m-cu normally joining vein M basad of junction of 2nd r-m and M; hind wing with vein R_s at least almost twice as long as r-m. Hind femora concolorous with, to slightly darker than, metasoma; suberect spinelike setae on outer surface of middle and hind tibiae long, stout, refracting white and hence concolorous with appressed setae. **Metasoma**: Integumental color reddish to pale reddish throughout except on one specimen which has terga IV–VI reddish brown. Dorsal marginal hair bands more or less conspicuous where present. Other features of metasoma (figs. 65, 66) as described for female of *O. euphorbiae*.

Male. Body length 3.2–4.25 mm; that of allotype 3.9 mm; length of forewing from tip of costal sclerite to apex 2.5–3.0 mm; that of allotype 2.65 mm. **Head**: Integumental color of vertex black; labrum very dark brown. **Mesosoma**: Mesoscutum, and mesoscutellum black; pleural region black to very dark brown. Legs with hind femur dark to very dark red-brown, always darker than red of metasoma. **Metasoma**: Usually metasomal terga I, II, and III red; tergum IV sometimes red; terga V to VII usually dark red-brown to black; occasionally terga I–III also suffused with brown, or dark tip of metasoma restricted to terga V and VI; pygidial plate apparently always reddish. Sternum IV with marginal area usually with setae, at least basally; sterna VII and VIII (figs. 62, 63) variable, in some cases asymmetrical, but similar to those of *O. euphorbiae*; genitalia similar to those of *O. euphorbiae* except gonocoxites (figs. 60, 61) less elongate.

HOLOTYPE: Female, 2 mi northeast of Portal, Cochise County, Arizona, September 23, 1961 (M. Cazier); allotype, same data, except May 25, 1962 (M. Mortensen, J. G. Rozen). The holotype and allotype are in the American Museum of Natural History.

PARATYPES: **Arizona**: *Cochise County*: same locality as holotype, June 25–29 and September 5–29 (M. A. Cazier, M. Mortensen, M. Statham, J. G. Rozen), 87 males, 19 females; Portal, June 15 (no collector), 1 female; 5 mi east of Portal, September 14 (G. E. Bohart), 1 female; 8 mi southeast of Portal, August 17, 18 (G., K. Eickwort), 3 females; Apache, August 8–September 8 (G., K. Eickwort, M. Favreau, R. McGinley, J. G., K. C. Rozen), 140 males, 29 females; 0.5 mi north of Apache, September 4, (R. R. Snelling), 14 males; 2 mi east of Apache, May 9 (J. G. Rozen), 1 female; Willcox, August 18–September 6 (R. M. Bohart, D. D. Linsdale, (?) Marsh, B. L., J. G. Rozen), 4 males, 6 females; Douglas, May 17, August 24 (M. Favreau, W. W. Jones, J. G. Rozen), 5 females; 1 mi east of Douglas, August 14–21 (M. A. Cazier, M. Favreau, J. G. Rozen, M. Statham), 1 male, 10 females; 16 mi northeast of Douglas, August 23–31 (S. Hessel, M. Statham, J. G. Rozen), 17 males, 55 females. Skeleton Canyon, Peloncillo Mountains, May 3 (J. G. Rozen), 3 females. *Graham County*: Fort Grant, Pinaleno Mountains, July 19, 2 males, 1 female; Bonita, July 12 (G. Salt), 6 males, 1 female. **New Mexico**: *Hidalgo County*: Rodeo, August 26, September 8 (R. M. Bohart, H. E. Evans), 1 male, 1 female; 1 and 11 mi north of Rodeo, June 20, August 19–28 (M., T. M. Favreau, R. J. McGinley, J. G., K. C. Rozen), 1 male, 6 females; 4 mi southwest of Rodeo, September 3 (J. G. Rozen), 1 female; 1.2 mi south of Rodeo, August 22 (J. G., D. W. Ehrenfeld), 1 female; 8–23 mi south of Animas, August 10–September 8 (G., K. Eickwort, M. Favreau, R. McGinley, B. L., J. G., K. C. Rozen), 17 males, 59 females. *Socorro County*: La Joya Wildlife Preserve, June 25–July 2 (H. E. Evans), 1 female. **Texas**: *Brewster County*: Santa Elena Canyon, Big Bend National Park, 2145 ft, April 24, August 25, 13 females. **Nebraska**: *Sioux County:* 7 mi north of Harrison, August 13 (J. G., B. L. Rozen), 12 males, 25 females. *Dawes County*: Fort Robinson, August 9–12 (R. McGinley, B. L., J. G., K. C. Rozen), 12 females.

ETYMOLOGY: This species is named in honor of Mrs. Marjorie Favreau, nèe Statham, whose field efforts contributed substantially to our learning about the biology of this genus.

REMARKS: This species and *Oreopasites euphorbiae* share many features, some of which seem to be specialized, i.e., five-segmented maxillary palpi, relatively flat face, and flat,

slanting pygidial area of the female. Except for *O. vanduzeei*, *O. favreauae* is the most widely distributed species in the genus in spite of its former rarity in collections. Although most specimens have been collected in late summer and early fall, a sufficient number of spring and early summer collections have been recorded (table 6) to indicate that the species either has more than one generation per year or time of emergence is protracted depending on local weather conditions.

Oreopasites favreauae exhibits a moderate amount of geographic variation. Specimens from Santa Elena Canyon, Big Bend National Park, Texas, are smaller and lighter colored that those from elsewhere. The individuals in long series from Nebraska tend to be darker than those from more southern localities.

Like *Oreopasites euphorbiae*, this species attacks the nests of *Micronomadopsis helianthi*. Eggs, larvae, and pupae have been taken from the cells of this host in southern Arizona and New Mexico, and larvae from nests in Nebraska. Numerous females of this cleptoparasite flew over the nesting site of *Mic. meliloti* 4 mi east of Willcox, Arizona, almost certainly indicating that this relative of *Mic. helianthi* is also a host. A single female from Santa Elena Canyon, Texas, was collected with *Mic. australior*, and another one from Douglas, Arizona, with *Hypomacrotera callops*, perhaps indicating a broader range of hosts.

Oreopasites powelli, new species
Figure 30

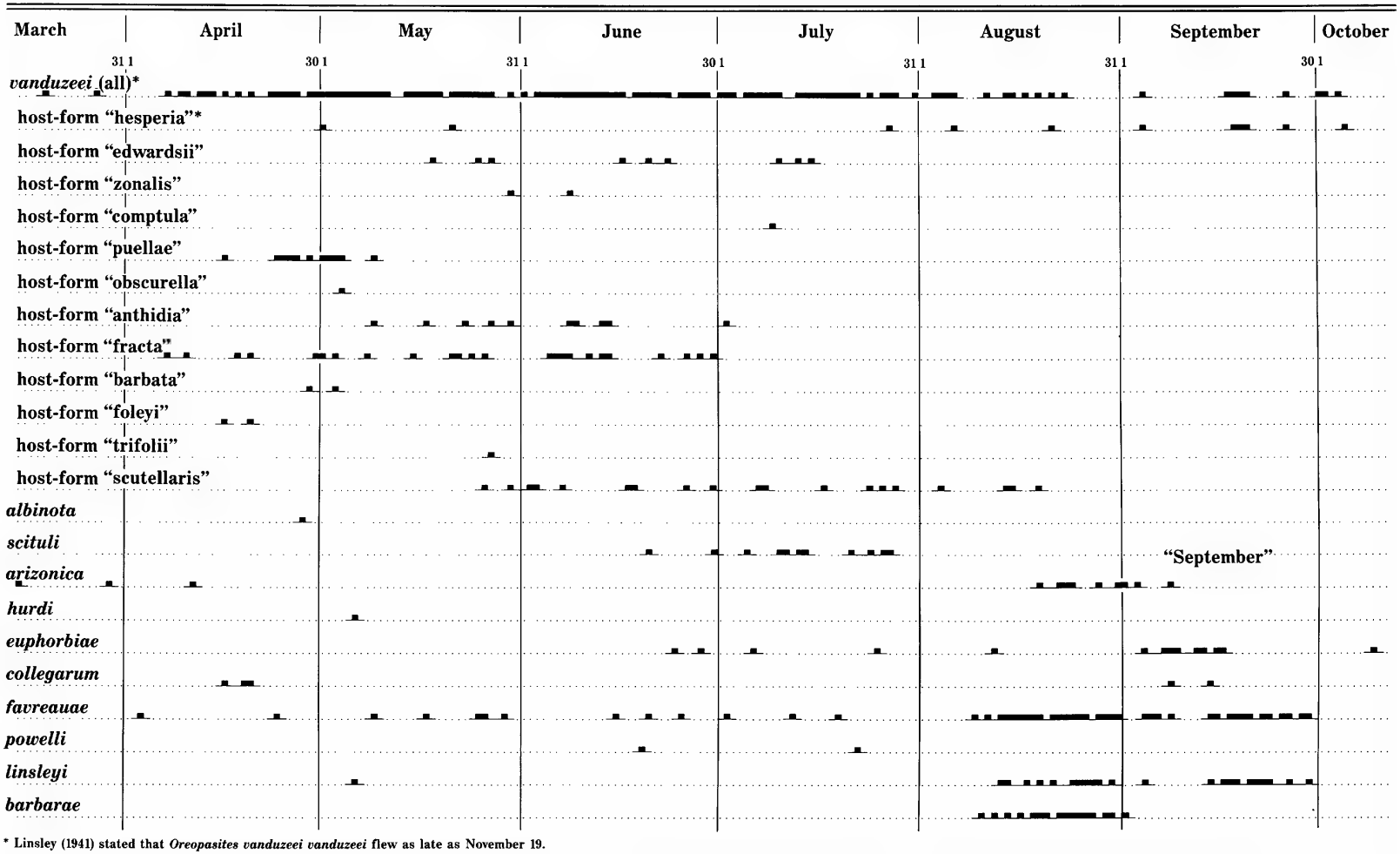
DIAGNOSIS: *Oreopasites powelli* is a small dark species, with relatively inconspicuous though abundant plumose hairs. It is nearly identical to *O. vanduzeei* in regard to male genitalia and associated sterna. It differs in that the scape is very short, the maxillary palpi are only four or five segmented (see footnote 6), and the ventral surface of the gena is less pilose.

DESCRIPTION: *Female*. Body length 2.8–3.45 mm; that of holotype 3.3 mm; length of forewing measured from tip of costal sclerite to apex 2.3–2.75 mm; that of holotype 2.6 mm. **Head**: Integumental color of vertex black; labrum medium brown, somewhat darker than red of metasoma. Setae between lateral ocellus and eye amberish to grayish, distinctly less plumose and darker than setae between antennal socket and eye; setae on antennal scape slightly less than one-third length of scape exclusive of basal ball. Inner orbits converging only very slightly below; clypeus protuberant; gena wide; occipital carina distinct above, fading out about halfway down gena as seen in lateral view. Scape, exclusive of basal ball, distinctly shorter than combined length of first three flagellomeres. Mouthparts sufficiently long so that in repose galeae extending to base of stipites; maxillary palpus with four to five short segments[6]; galea apicad of palpal insertion about equal to maximum eye length in lateral view; labial palpus four-segmented, with approximate ratio of segments 1/2/3+4 : 1.5/1.0/0.3. **Mesosoma**: Mesoscutum and mesoscutellum very dark brown to black; pleural regions very dark brown to almost black. Recumbent setae of mesoscutum amberish, not very plumose except near tegulae where they are whitish and somewhat more plumose; discal setae sparse and short; mesoscutal disk polished between moderately dense, evenly spaced punctures. Forewing with distal end of marginal cell obliquely truncate, with lower apical angle extending beyond upper angle; vein 2nd m-cu joining M slightly basad of junction of 2nd r-m and M; hind wing with vein R_s at least 1.5 times length of r-m. Hind femora pale reddish brown, at most only slightly darker, but somewhat more brownish than red on metasoma; suberect spinelike setae on outer surface of middle and hind tibiae moderate in length, stout, and reflecting amber, distinct from appressed setae. **Metasoma**: Integumental color pale brownish red, gradually becoming darker on terga III to VI or IV to VI, where dark color is medium reddish brown. Dorsal marginal hair bands inconspicuous because setae not dense. Tergum VI, as seen in lateral view, with dorsal silhouette moderately curved except near apex where it bends rather abruptly downward. Sternum

[6] On at least one specimen, the first segment of the maxillary palpus fuses with the second, although the crescentic shape of the first is maintained. Furthermore, the two terminal segments are partly fused on several specimens. However, the maximum number of segments appears to be five.

TABLE 6

Temporal Distribution of Species of *Oreopasites* as Revealed by Dates of Collection



* Linsley (1941) stated that *Oreopasites vanduzeei vanduzeei* flew as late as November 19.

III with marginal area bearing some setae, especially laterally; sternum IV with marginal area glabrous except for few scattered setae laterally; sternum V with subapical hair collar forming a deep inverted V; laterally, collar consisting of numerous short setae which become much sparser mesially; sternum VI about as in *O. vanduzeei*.

Male. Body length 3.2–3.75 mm; that of allotype 3.55 mm; length of forewing measured from tip of costal sclerite to apex 2.5–2.8 mm; that of allotype 2.65 mm. **Head**: As described for female except labrum dark brown to dark reddish brown. **Mesosoma**: As described for female except hind femora medium to dark reddish brown, distinctly darker than red on metasoma. **Metasoma**: Integumental color pale brownish red to reddish on terga I, II, and part of III; terga IV, V, and VI dark reddish brown to very dark reddish brown; tergum I often with large brownish infuscation on each side. Sternum IV with marginal area setose; sterna VII, VIII, and genitalia similar to those of *O. vanduzeei*.

HOLOTYPE: Female, male allotype, Castle Lake, Siskiyou County, California, July 22, 1958 (J. A. Powell). The holotype and allotype are on long-term loan from the Essig Museum of Entomology, University of California, Berkeley, to the California Academy of Sciences.

PARATYPES: **California**: *Siskiyou County*: Same as holotype, 12 males, 1 female. *Yuba County*: 5 mi south of Camptonville, June 19 (M. Wasbauer), 2 males, 2 females.

ETYMOLOGY: This species is named in honor of Dr. Jerry A. Powell who first discovered this species.

REMARKS: *Oreopasites powelli*, known from only two localities in northern California, is similar in many respects, including male genitalia, to *O. vanduzeei*. Its host is unknown.

Perditopasites, new subgenus

This subgenus is proposed for two small to minute species of *Oreopasites* that are cleptoparasites of the panurgine genus *Perdita*.

DIAGNOSIS/DESCRIPTION: Generally more slender and elongate than the species in the subgenus *Oreopasites*, the two known species of this subgenus can be recognized by the well-developed occipital carina that extends all the way down the posterior margin of the gena and nearly reaches the hypostomal carina on each side. In *Oreopasites* s.s. this carina always disappears well before reaching the level of the lower eye margin. The setae on the antennal scape tend to be much shorter than those of *Oreopasites* s.s. Vein R_s of the hind wing (fig. 69) is very short so that it is subequal to vein r-m, rather than at least 1.5 (but usually at least 2) times the length of r-m (fig. 68), the plesiomorphic condition found in *Oreopasites* s.s. and *Ammobates*. The dorsal surface of the female metasomal tergum VI is much flatter in lateral view than in *Oreopasites* s.s. The spinelike setae on the tibiae (fig. 71) are more slender, more decumbent, and less conspicuous by comparison with the species in *Oreopasites* s.s. (fig. 70), perhaps because *Perditopasites* females descend the open burrows of *Perdita*. Females of *Oreopasites* s.s. have elongate (compared with the plumose), robust, suberect spinelike setae intermixed with the normal vestiture, probably a fossorial adaptation permitting them to crawl through the soil-filled tunnels of their hosts (*Nomadopsis, Macronomadopsis, Micronomadopsis*, and *Hypomacrotera*).

TYPE SPECIES: *Oreopasites linsleyi*, new species. Other included species: *Oreopasites barbarae*, new species.

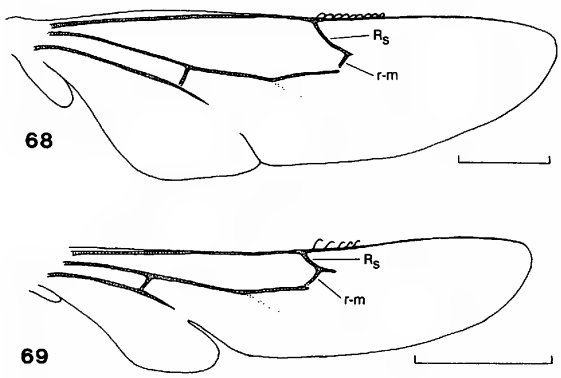
ETYMOLOGY: *Perdito-*, a reference to the host genus of the known species, and *-pasites*, a name often associated with small nomadine bees other than *Nomada* and the Epeolini.

Oreopasites linsleyi, new species

Figures 19, 69, 71–81

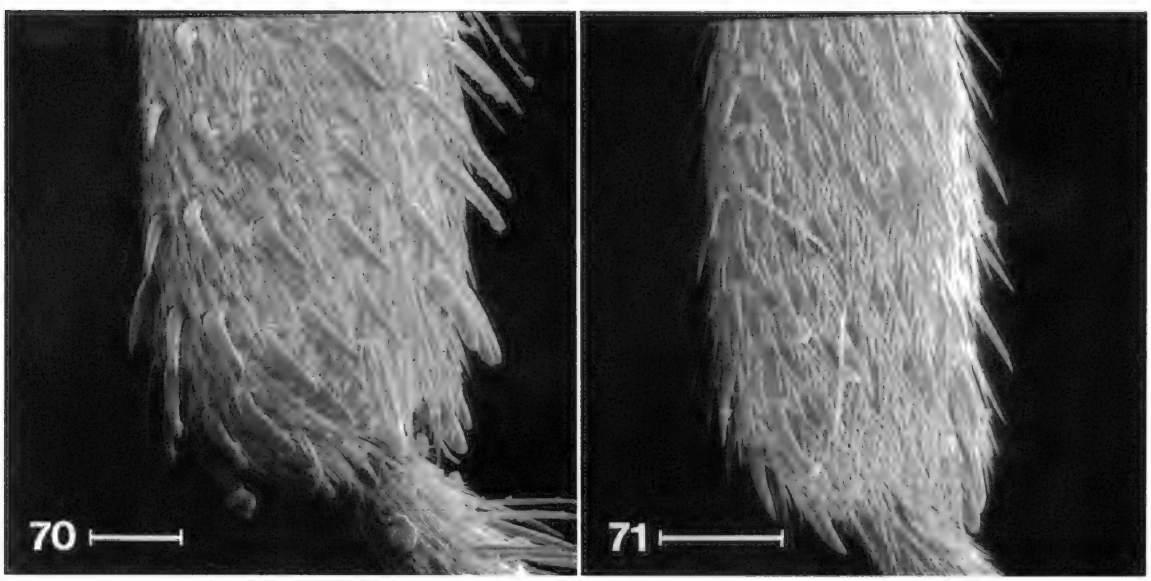
DIAGNOSIS: This small species is about the same size as *Oreopasites euphorbiae* and *O. favreauae*, but its more slender body form, reduced setal plumosity, and dark metasomal apex of the female contrast with those of the other two species. The black metasomal apex and the presence of setae on the marginal area of the third metasomal sternum permit females of *O. linsleyi* to be separated from those of *O. favreauae* and *O. euphorbiae*. The longer mouthparts readily distinguish males from those of the other two species. Furthermore, the mesoscutum of both sexes of *O. linsleyi* is significantly more densely punctated.

DESCRIPTION: *Female*. Body length 3.5–4.3



Figs. 68, 69. Right hind wings of *Oreopasites*. **68**. *O. vanduzeei*. **69**. *O. linsleyi*. Scale lines (= 0.5 mm) as indicated.

mm; that of holotype 4.2 mm; length of forewing measured from tip of costal sclerite to apex 2.5–3.0 mm; that of holotype 2.7 mm. **Head**: Integumental background color of vertex black; labrum when extended pale reddish to reddish to reddish brown, usually approximately concolorous with background color of metasoma; labrum quite transparent, hence, when folded, may appear darker. Setae between lateral ocellus and eye white but not strongly plumose, less plumose than those between antennal socket and eye; setae on antennal scape extremely short, longer ones being approximately one-seventh length of scape exclusive of basal ball; hence setae much shorter than those of *O. euphorbiae* and *O. favreauae*. Inner orbits converging more or less below; clypeus (fig. 81) rather long and slightly more protuberant than in *O. euphorbiae* and *O. favreauae*; gena (fig. 81) very wide; occipital carina (fig. 81) well developed, extending nearly to lower eye margin. Scape, exclusive of basal ball, and combined first three flagellomeres subequal in length. Mouthparts long so that in repose galeae extending to base of stipites; maxillary palpus five-segmented although there is some indication that segments may coalesce on some specimens; galea apicad of palpal insertion distinctly longer than maximum eye length in lateral view; labial palpus (fig. 78) four-segmented, with approximate ratio of segments 1/2/3+4 : 1.3/1.0/0.35. **Mesosoma**: Mesoscutum black; mesoscutellum very dark red-brown to almost black; pleural regions dark reddish brown to very dark reddish brown. Recumbent setae on mesoscutum white; discal setae on mesoscutum of unworn specimens very dense but scarcely, if at all, plumose, hence inconspicuous; mesoscutal disk polished between dense, evenly spaced punctures. Forewing with distal end of marginal cell sharply truncate, with lower apical



Figs. 70, 71. Scanning micrographs of outer surface of left middle tibiae of *Oreopasites* showing differences in spinelike setae. **70**. *O. vanduzeei*. **71**. *O. linsleyi*. Scale lines = 100 μm.

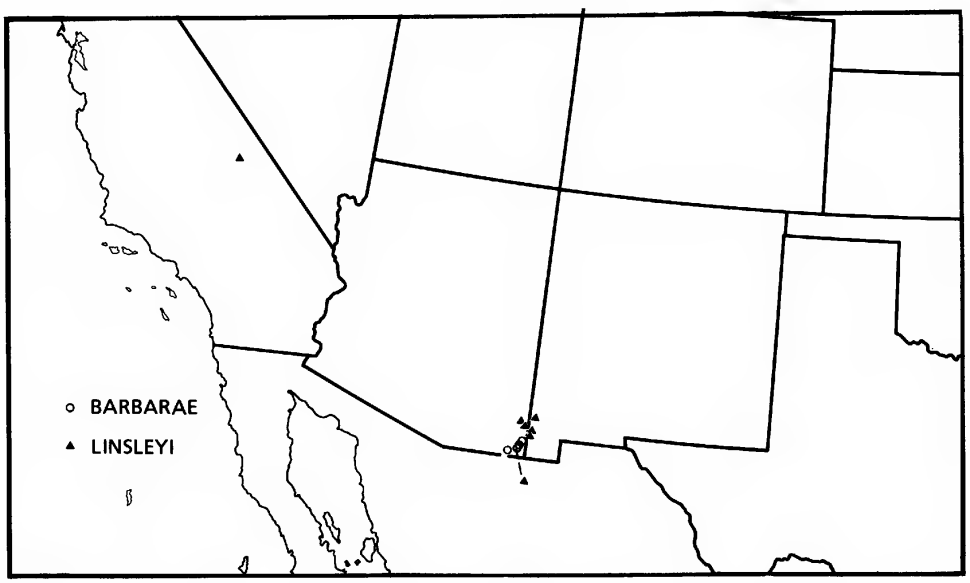


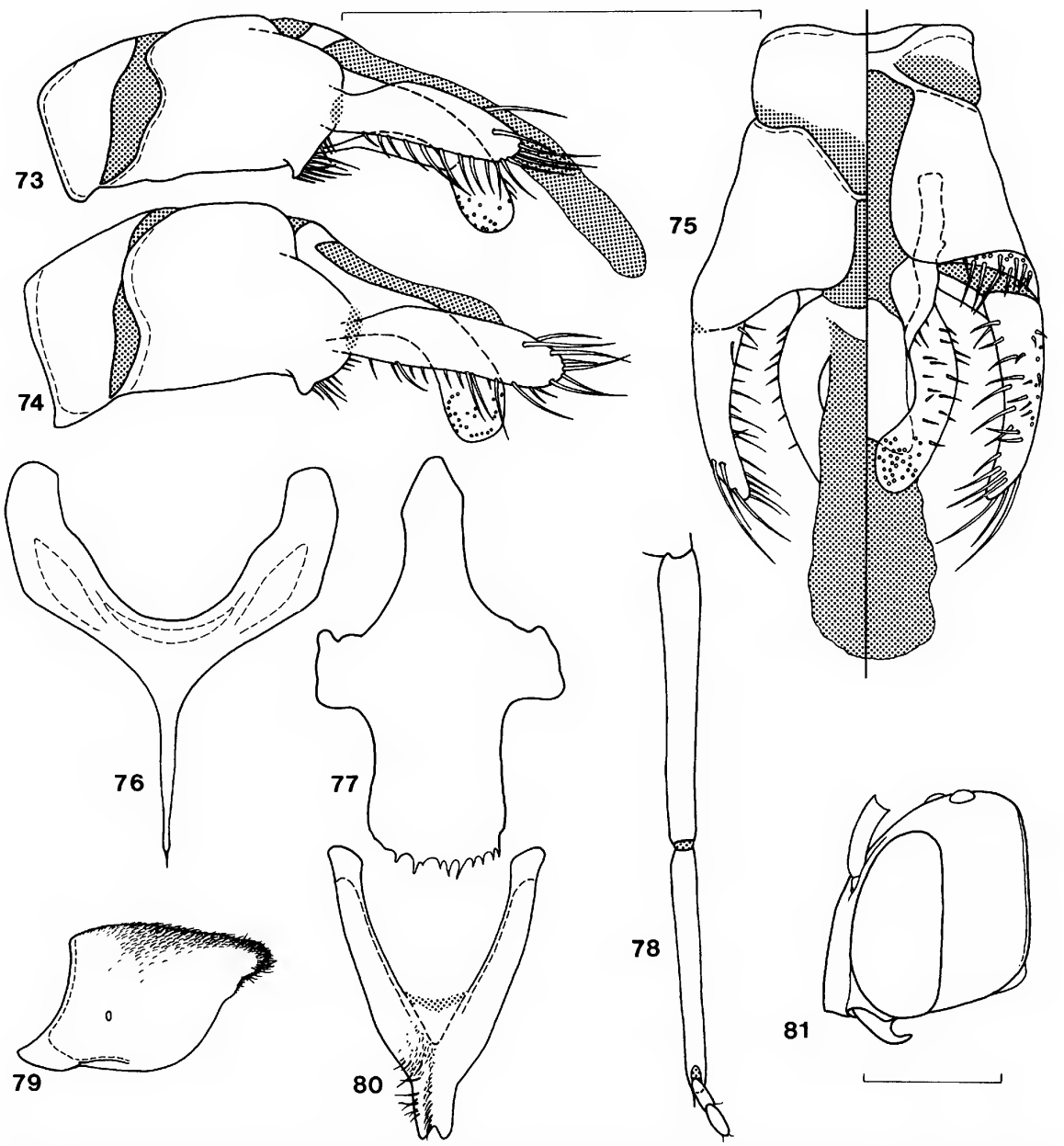
Fig. 72. Distribution of *Oreopasites barbarae* and *O. linsleyi*.

angle slightly exceeding upper angle; vein 2nd m-cu joining M somewhat basad of junction of 2nd r-m and M; hind wing (fig. 71) with veins R_s and r-m subequal in length. Hind femora concolorous with red background color of metasoma, to medium brown; suberect spinelike setae on outer surface of middle and hind tibiae short, slender, refracting white, scarcely distinguishable from appressed setae. **Metasoma**: Integumental color reddish at base; terga VI, usually V, sometimes IV, and less frequently posterior margins of anterior segments brown to almost black. Dorsal marginal hair bands conspicuous, being composed of white plumose setae. Tergum VI, as seen in lateral view (fig. 79), with dorsal surface only gently curved. Sternum III (fig. 19) with marginal area setose except perhaps near posterior edge; sternum IV as described for sternum III or with glabrous posterior area more extensive; sternum V (fig. 19) with subapical hair collar as described for *O. euphorbiae*; sternum VI (fig. 80) short, similar to that of *O. euphorbiae*.

Male. Body length 3.4–4.75 mm; that of allotype 4.0 mm; length of forewing measured from tip of costal sclerite to apex 2.5–2.75 mm; that of allotype 2.5 mm. **Head**: As described for female. **Mesosoma**: As described for female except pleural regions tending to be very dark brown to black and legs darker so that hind femur dark brown to very dark brown. **Metasoma**: Coloration as described for female except terga V to VII dark brown to very dark brown and sometimes tergum IV, and even III, partly dark. Sternum IV with much of marginal area setose, at least basally; shape of sternum VII (fig. 76) somewhat variable, with medium process tending to be very slender; sternum VIII (fig. 77) short; gonocoxites, as seen in ventral view (fig. 75), broad apically, more so than those of *O. favreauae*, and even more so than those of *O. euphorbiae*; gonocoxites in lateral view (fig. 73, 74) low, variable in shape, about as high as gonobase, lower therefore than those of *O. euphorbiae* and *O. favreauae*.

HOLOTYPE: Female, 5 mi north of Rodeo, Hidalgo Co., New Mexico, August 26, 1966, taken from burrows of *Perdita callicerata* Cockerell (determined by P. H. Timberlake), (B. L., J. G. Rozen); allotype, same locality, August 28, 1966 (B. L., J. G. Rozen). The holotype and allotype are in the American Museum of Natural History.

PARATYPES: **New Mexico**: *Hidalgo County*: Same locality as holotype, August 18–30 (B. L., J. G., K. C., S. G. Rozen), 6 males, 17 females; 4.8 mi north of Rodeo, September 4 (P. D. Hurd), 50 males, 13 females; 21.4 mi north of Rodeo, August 25 (R. R. Snell-



Figs. 73–81. *Oreopasites linsleyi*. **73–75**. Male genitalia, lateral, dorsal, and ventral views. **76**. Male metasomal sternum VII. **77**. Male metasomal sternum VIII, ventral view. **78**. Labial palpus, ventral view. **79**. Female metasomal tergum VI, lateral view. **80**. Female metasomal sternum VI, ventral view. **81**. Female head, lateral view. Scale lines (= 0.5 mm) refer to figures 73–75 and 81, respectively.

ing), 1 female; 4.5 mi north of Rodeo, August 21 (S. Hessel, J. G. Rozen, M. Statham), 1 female; 4 mi north of Rodeo, August 24 (L. R. Espinoza, G. B. Quistad), 1 male, 3 females; 1 mi north of Rodeo, August 13, September 21, 22 (M. Favreau, B. L., J. G. Rozen), 1 male, 2 females; Rodeo, September 21 (R. M. Bohart), 1 female. **Arizona**: *Cochise County*: 2 mi northeast of Portal, September 14–26 (M. A. Cazier, J. G. Rozen, M. Statham), 3 males, 10 females; 17.5 mi southwest of Apache, August 14, 24 (J. G., K. C. Rozen), 2 males, 1 female; Tex Canyon Road, 17 mi northwest of junction of highway 80, August 11 (M. Wasbauer, J. Slansky, C. Freeburg), 1 male; 5 mi northwest of Rodeo, N.

M., September 22, 29 (M. A. Cazier, M. Statham), 4 males, 9 females. **California**: *Inyo County*: Panamint Springs, May 6 (F. D. Parker), 1 female.

ETYMOLOGY: This species is named for Dr. E. Gorton Linsley, who revised the genus *Oreopasites* in 1941 and who envisioned the possibility that a detailed systematic and biological study of a small group of parasitic bees such as this, in conjunction with a similar study of its hosts, might lead to a broader understanding of the variation, systematics, and phylogeny of other groups of parasitic bees.

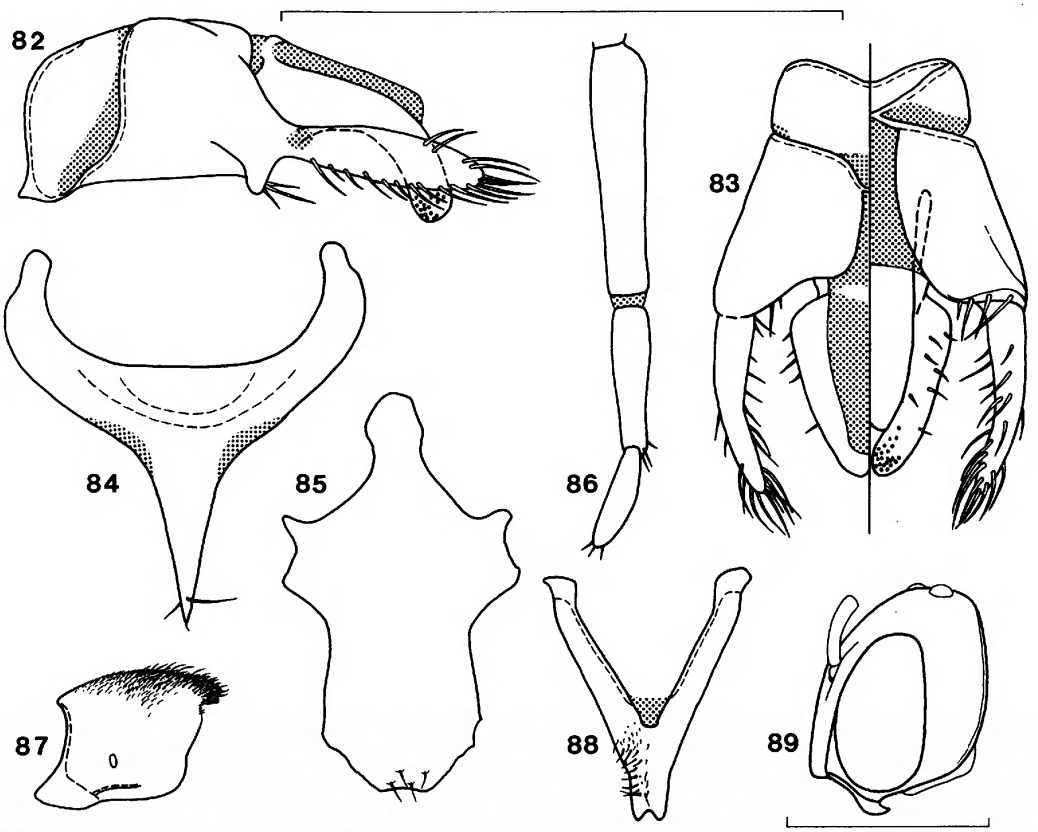
REMARKS: Before the single female was collected in May from Panamint Springs, California, this species was considered to be a late summer, early fall species (table 6) restricted to a small area near the Chiricahua Mountains in southeastern Arizona (figs. 10, 72).

Females of *O. linsleyi* were flying over the nesting site of *Perdita (Hexaperdita) callicerata* at 5 mi north of Rodeo, New Mexico, August 26, 1966. A number of them descended into *Perdita* burrows and remained there for several minutes. This activity leaves little doubt that the cuckoo bee is a parasite of the *Perdita*. Unfortunately, the ground was dry, powdery and almost impossible to excavate, even though one burrow was excavated to a depth of 31 cm before it was lost. Immatures of this *Oreopasites* were not recovered from the cells of the host.

Oreopasites barbarae, new species
Figures 72, 82–89

DIAGNOSIS: Minute and with the slender aspect of *Oreopasites linsleyi*, this is the smallest species in the genus and one of the smallest bees in the world. Its reduced size and often darker coloration will usually permit it to be distinguished from *O. linsleyi*. It can be separated from all other *Oreopasites* including *O. linsleyi* on the basis of its four-segmented maxillary palpi and the three-segmented labial palpi (fig. 86).

DESCRIPTION: *Female*. Body length 2.2–2.8 mm; that of holotype 2.3 mm; length of forewing measured from tip of costal sclerite to apex 1.65–2.05 mm; that of holotype 1.9 mm. **Head**: Integumental color of vertex black to very dark brown; labrum reddish to pale brown, usually concolorous with light areas on metasoma. Setae between lateral ocellus and eye white but not strongly plumose, less so than those between antennal socket and eye; setae on antennal scape very short, less than one-quarter length of scape exclusive of basal ball. Inner orbits converging below; clypeus short, scarcely protuberant, about as in *Oreopasites linsleyi*; gena (fig. 89) moderately narrow, unlike that of *O. linsleyi*; occipital carina well developed, extending to lower margin of eye in lateral view (fig. 89). Scape, exclusive of basal ball, and combined first three flagellomeres subequal in length. Mouthparts short but galeae in repose extending to base of stipites; maxillary palpus four-segmented; galea apicad of palpus considerably shorter than maximum eye length in lateral view; labial palpus three-segmented, with approximate ratio of segments 1/2/3 : 1.7/1.0/0.7. **Mesosoma**: Mesoscutum very dark brown to black; mesoscutellum dark brown to very dark brown; pleural regions dark brown to very dark brown. Recumbent setae on mesoscutum white; discal setae on mesoscutum of unworn specimens very sparse, scarcely, if at all, plumose, hence inconspicuous; mesoscutal disk shiny between sparse, regularly spaced punctures. Forewing with distal end of marginal cell sharply truncate, with upper apical angle slightly exceeding lower angle, in contrast to situation in *O. linsleyi*; vein 2nd m-cu and 2nd r-m tending to join M essentially at same point; hind wing with veins R_s and r-m subequal in length. Hind femora medium brown, hence darker than light color of metasoma; suberect spine-like setae on outer surface of hind tibiae moderately long but slender, refracting white, and therefore scarcely distinguishable from appressed setae. **Metasoma**: Integumental color of terga I and II reddish to brownish red; tergum III sometimes partly or nearly entirely medium reddish brown; other terga reddish brown; terga I and II occasionally partly suffused with brown. Dorsal marginal hair bands inconspicuous because white plumose hairs scarce. Tergum VI (fig. 87), as seen in lateral view, with dorsal edge only gently curved, about as in *O. linsleyi*. Sterna III and IV with marginal areas setose; sternum V (fig. 88) with subapical hair collar approximately



Figs. 82–89. *Oreopasites barbarae*. **82, 83**. Male genitalia, lateral, dorsal, and ventral views. **84**. Male metasomal sternum VII, ventral view. **85**. Male metasomal sternum VIII, ventral view. **86**. Labial palpus. **87**. Female metasomal tergum VI, lateral view. **88**. Female metasomal sternum VI, ventral view. **89**. Female head, lateral view. Scale lines (= 0.5 mm) refer to figures 82 and 83, and 89, respectively.

as described for *O. euphorbiae*; sternum VI similar to that of *O. euphorbiae* and *O. linsleyi* except even shorter.

Male. Body length 2.2–3.1 mm; that of allotype 2.25 mm; length of forewing from tip of costal sclerite to apex 1.6–2.0 mm; that of allotype 1.7 mm. **Head**: As described for female except labrum pale reddish brown, at least when extended. **Mesosoma**: As described for female except for following: discal setae of mesoscutum somewhat more abundant and plumose, hence more conspicuous; hind femora medium brown to dark brown. **Metasoma**: Integumental color usually brown; pregradular areas and marginal areas of terga tending to be somewhat paler than rest of terga; hence metasoma appearing to be indistinctly banded, particularly anteriorly; some specimens with terga I and II partly or even completely reddish. Sternum IV with much of marginal area setose; sterna VII and VIII (figs. 84, 85) asymmetrical and probably with variable shape; genitalia (figs. 82, 83) as described for male of *O. linsleyi*.

HOLOTYPE: Female, male allotype, 13 mi southwest of Apache, Cochise County, Arizona, August 22, 1966 (J. G. and K. C. Rozen). The holotype and allotype are in the American Museum of Natural History.

PARATYPES: **Arizona**: *Cochise County*: Same locality as holotype, August 10–September 1 (J. G., D. Ehrenfeld, M. Favreau, R. McGinley, B. L., J. G., K. C. Rozen), 79 males, 70 females; 17.5 mi southwest of Apache, August 14–25 (J. G. Rozen, K. C. Rozen), 12 males, 38 females; 1 mi north of Douglas, August 29 (G. Krueger, J. G. Rozen), 1 female; 28 mi north of Douglas, highway 80, August 12 (M. Wasbauer, J. Slansky), 2 males, 4 females.

ETYMOLOGY: This species is named in honor of my wife, Barbara L. Rozen, who helped to collect the first two specimens in 1964, and who has contributed substantially to many field trips before and since then.

REMARKS: Although many specimens of this species have been collected, they were taken at only three localities, all in Cochise County, Arizona. Specimens have been collected from 1964 to 1990 at 13 mi southwest of Apache. Although their abundance has varied yearly, it is interesting that this population has persisted for so long a time. Populations of other species seem to disappear or at least to shift geographically. Larvae were recovered from the cells of *Perdita (Perdita) obscurella* at 13 mi southwest of Apache, over a number of years. A first instar was discovered in the nest of *P. (Epimacrotera) biguttata* at the same locality. This species and *Oreopasites linsleyi* are the only two known to attack the nests of species of *Perdita*.

As is characteristic of many minute bees, the veins of the forewing are restricted to the basal part of the wing unlike larger members of the genus (Danforth, 1989).

REFERENCES

Alexander, B.
1990. A cladistic analysis of the nomadine bees (Hymenoptera: Apoidea). Syst. Entomol. 15: 121–152.

Bohart, G. E.
1970. The evolution of parasitism among bees. Utah State Univ. 41st Honor Lecture, Spring 1970, The Faculty Assoc. 33 pp.

Cockerell, T. D. A.
1906. The bees of Florissant, Colorado. Bull. Am. Mus. Nat. Hist. 25: 419–455.
1925. XI. Bees in the collection of California Academy of Sciences. Proc. California Acad. Sci. 14: 185–215.
1929. Some Californian parasitic bees. Pan-Pacific Entomol. 5: 101–105.

Danforth, B. N.
1989. The evolution of hymenopteran wings: the importance of size. J. Zool. London 218: 247–276.

Farris, J. S.
1988. Hennig86 Reference, Version 1.5. Available from J. S. Farris.

Grütte, E.
1935. Zur Abstammung der Kuckucksbienen (Hymenopt. Apid.). Arch. Naturgeschichte, N.F., 4: 449–534.

Hurd, P. D., and E. G. Linsley
1972. Parasitic bees of the genus *Holcopasites* Ashmead (Hymenoptera: Apoidea). Smithson. Contrib. Zool. 114: 41 pp.

Linsley, E. G.
1941. A revision of the genus *Oreopasites* (Hymenoptera: Nomadidae). Trans. Am. Entomol. Soc. 66: 307–318.

Linsley, E. G., and C. D. Michener
1939. A generic revision of the North American Nomadidae (Hymenoptera). Trans. Am. Entomol. Soc. 65: 265–305.

Michener, C. D.
1944. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). Bull. Am. Mus. Nat. Hist. 82: 151–326.

Popov, V. B. [V. V.]
1931. To the knowledge of the genera *Pasites* Jurine and *Parammobatodes* gen. nov. (Hymenoptera, Nomadidae). Ann. Musée Zool. Acad. Sci. URSS 32: 453–467.
1937. Zur Kenntnis der Bienengattung *Parammobatodes* Popov (Hymenoptera, Apoidea). Konowia 16: 10–14.
1944. Some parasitic bees from Cyprus (Hymenoptera, Apoidea). Proc. R. Entomol. Soc. London (B)13: 120–124.
1951. The parasitic bees of the genus *Ammobates* Latr. (Hymenoptera, Anthophoridae). Trans. Zool. Inst. URSS, Moscow 9: 895–949.

Roig-Alsina, A.
1991. Cladistic analysis of the Nomadinae s. str. with description of a new genus (Hymenoptera: Anthophoridae). J. Kansas Entomol. Soc. 64: 23–37.

Rozen, J. G.
1954. Morphological description of the larva of *Oreopasites vanduzeei* Cockerell (Hymenoptera: Anthophoridae). Pan-Pacific Entomol. 30: 203–207.
1958. Monographic study of the genus *Nomadopsis* Ashmead (Hymenoptera: Andrenidae). Univ. California Publ. Entomol. 15: 202 pp.
1963. Notes on the biology of *Nomadopsis*, with descriptions of four new species (Apoidea, Andrenidae). Am. Mus. Novitates 2142: 17 pp.
1967. Review of the biology of panurgine bees, with observations on North American forms (Hymenoptera, Andrenidae). Am. Mus. Novitates 2297: 44 pp.
1968. Review of the South African cuckoo-bee genus *Pseudodichroa* (Hymenoptera, Apoidea). Am. Mus. Novitates 2347: 10 pp.

1969. Biological notes on the bee *Tetralonia minuta* and its cleptoparasite, *Morgania histrio transvaalensis* (Hymenoptera: Anthophoridae). Proc. Entomol. Soc. Washington 71: 102–107.
1970. Biology and immature stages of the panurgine bee genera *Hypomacrotera* and *Psaenythia* (Hymenoptera, Apoidea). Am. Mus. Novitates 2416: 16 pp.
1971. Biology and immature stages of Moroccan panurgine bees (Hymenoptera, Apoidea). Am. Mus. Novitates 2457: 37 pp.
1986. The natural history of the Old World nomadine parasitic bee *Pasites maculatus* (Anthophoridae: Nomadinae) and its host *Pseudapis diversipes* (Halictidae: Nomiinae). Am. Mus. Novitates 2861: 8 pp.
1989. Life history studies of the "primitive" panurgine bees (Hymenoptera: Andrenidae: Panurginae). Am. Mus. Novitates 2962: 27 pp.
1991. Evolutionary origins of cleptoparasitism in anthophorid bees as revealed by their mode of parasitism and first instars (Hymenoptera: Apoidea). Am. Mus. Novitates 3029: 36 pp.

Rozen, J. G., and R. J. McGinley
1974. Systematics of ammobatine bees based on their mature larvae and pupae (Hymenoptera, Anthophoridae, Nomadinae). Am. Mus. Novitates 2551: 16 pp.
1991. Biology and larvae of the cleptoparasitic bee *Townsendiella pulchra* and nesting biology of its host *Hesperapis larreae* (Hymenoptera: Apoidea). Am. Mus. Novitates 3005: 11 pp.

Rozen, J. G., and C. D. Michener
1968. The biology of *Scrapter* and its cuckoo bee, *Pseudodichroa* (Hymenoptera: Colletidae and Anthophoridae). Am. Mus. Novitates 2335: 13 pp.

Rozen, J. G., and A. Roig-Alsina
1991. Biology, larvae, and oocytes of the parasitic bee tribe Caenoprosopidini (Hymenoptera: Anthophoridae: Nomadinae). Am. Mus. Novitates 3004: 10 pp.

Rozen, J. G., and B. L. Rozen
1966. Mature larvae of the Old World bee genus *Panurgus* (Hymenoptera, Apoidea). J. New York Entomol. Soc. 74: 92–94.

Rozen, J. G., K. R. Eickwort, and G. C. Eickwort
1978. The bionomics and immature stages of the cleptoparasitic bee genus *Protepeolus* (Anthophoridae, Nomadinae). Am. Mus. Novitates 2640: 24 pp.

Rust, R. W.
1988. Biology of *Nomadopsis larreae* (Hymenoptera: Andrenidae), with an analysis of yearly appearance. Ann. Entomol. Soc. Am. 81: 99–104.

Ruz, L.
1987. Classification and phylogenetic relationships of panurgine bees (Hymenoptera–Andrenidae). Ph.D. thesis, Univ. Kansas.
1991. Classification and phylogenetic relationships of the panurgine bees: the Calliopsini and allies (Hymenoptera: Andrenidae). Univ. Kansas Sci. Bull. 54: 209–256.

Shanks, S. S.
1977. A revision of the cleptoparasitic bee genus *Neolarra* (Hymenoptera: Anthophoridae). Wasmann J. Biol. 35: 212–246.

Shinn, A. F.
1967. A revision of the bee genus *Calliopsis* and the biology and ecology of *C. andreniformis* (Hymenoptera, Andrenidae). Univ. Kansas Sci. Bull. 46: 753–936.

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